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MECHANICAL TRANSMISSION OF A MOSAIC VIRUS FROM ABACÁ TO CORN [1]

M. S. Celino and Aureo L. Martinez [2]

WITH TWO PLATES

Mosaic of abacá with severe mottling was successfully communicated to corn seedlings by *Aphis gossypii*. The virus was recovered by the aphid from corn, and it induced again the characteristic severe form of mottling on abacá seedlings in retransmission experiments.

Inoculation of abacá mosaic to corn seedlings by pinpricks induced in 8 per cent of the plants inoculated a mosaic infection, which, when retransmitted by *Aphis gossypii* or *A. maidis* to abacá seedlings, induced a mild form of mosaic. Subsequent retransmission of the virus to other abacá seedlings directly or via corn produced consistently a mild mosaic infection.

The incubation periods of mild mosaic in abacá vary from 43 to 78 days; those of the severe form of mosaic, 8 to 21 days. Abacá plants with mild mosaic were readily infected by mosaic of the severe type in transmission experiments. The virus of the mild form of abacá mosaic appears to be distinct from the virus which causes the destructive and severe type of mottling.

The transmission of abacá mosaic to abacá (*Musa textilis* Née) and *Canna indica* L. by *Aphis gossypii* Glover, *A. maidis* Fitch, *Rhopalosiphum nympheae* L., and *R. prunifoliae* Fitch and to corn by *A. maidis* has been reported previously (Celino, 1940; Celino and Ocfemia, 1941; Ocfemia and Celino, 1938). In addition, Castillo listed the leafhopper, *Proutesta moesta* Westwood, as a vector also of abacá mosaic in Davao.[3] Heretofore, however, all attempts to transmit the disease to healthy abacá seedlings by needle pricks, sap injection, leaf contact, and corm and root contacts have yielded negative results (Celino, 1940; Juliano, 1951).

As previous attempts to transmit abacá mosaic by different mechanical methods failed to induce infection on any of the experimental abacá plants, studies were conducted with corn seedlings as suscepts. Corn was selected for study since insect transmission

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[1] Central Experiment Station Contribution No. 1858.

[2] The writers are grateful to Dr. G. O. Ocfemia, professor of plant pathology, for valuable suggestions on the work and the manuscript.

[3] B.S. Castillo, "Chart of Hosts and Vectors of Abacá Mosaic." (Exhibited at abacá mosaic control schools, Davao City, Sept. 8-11, 1953.)

experiments in 1941 had shown it to be susceptible to infection by abacá mosaic.

MATERIALS AND METHODS

The experiments were performed in the greenhouse of the Department of Plant Pathology. In the insect transmission experiments the method originally described by Ocfemia (1930) for transmitting bunchy-top of abacá was used. In transmitting abacá mosaic to corn by manual means the method reported by Sein (1930) for artificially transmitting sugar cane mosaic was used with slight modification. Unless otherwise stated, the virus source plants were mosaicked abacá obtained from Davao, Mindanao.

The experimental abacá seedlings were grown from seeds of healthy abacá plants, variety Puti. Corn seedlings of the variety Calauan Yellow Flint grown in pots in the laboratory were used as test plants.

TRANSMISSION OF ABACA MOSAIC TO CORN

By Aphis gossypii Glover

The transmission of abacá mosaic to corn by *Aphis maidis* was reported in 1941. As *A. gossypii* is one of the vectors of abacá mosaic, its ability to transmit the disease to corn was likewise studied. On March 15, 1955, 50 aphids from a culture of *A. gossypii* on mosaicked abacá plants were transferred to each of six young corn seedlings. These abacá plants were stunted and showed on the leaves a severe type of mottling (Pl. 1, fig. 1). Corn seedlings on which were colonized aphids from a healthy abacá plant served as control. In this experiment only two of the inoculated corn plants became mosaicked after 14 and 25 days.

From April 11 to 14, 1955, six other corn seedlings were used similarly in mosaic transmission tests. Another batch of six corn seedlings served as control. In this trial three plants of the experimental lot became mosaicked with respective incubation periods of 11, 12, and 12 days. In subsequent experiments, the abacá mosaic virus was successfully recovered from the artificially infected corn plants either by *A. gossypii* or *A. maidis*. When communicated back by the aphids to young abacá seedlings, the virus produced on these plants a mosaic infection characterized by intense mottling. Of the eight abacá seedlings used in the virus recovery tests from May 23 to 26, 1955, five plants developed mosaic symptoms of the severe type. The periods of incubation ranged from 13 to 18 days.

From the abacá seedlings artificially infected with abacá mosaic in the virus recovery tests, the inoculum was retransmitted successfully to healthy corn seedlings. From these mosaicked corn plants the disease was transmitted back to abacá seedlings by *A. gossypii.* It was observed that the abacá plants in the reinoculation tests developed mosaic symptoms characterized by intense mottling. These symptoms were similar to those shown on the leaves of the virus source plants (Pl. 1, figs. 1 and 2).

It appears from the results obtained that another mosaic virus was successfully communicated to corn by *A. gossypii.* It is evident further that the infecting power of this virus was not altered or reduced by its passage through corn.

Transmission of abacá mosaic to corn by pinpricks

Experiment 1. Twelve healthy corn seedlings 10 to 14 days old were inoculated on December 22, 1954. An abacá plant with a severe form of mosaic was used as virus source. Leaf pieces about 1 × 4 cm. each were cut from a severely mottled leaf. Two pieces were inserted between the leaf sheaths on opposite sides of each corn stem and then pricked repeatedly from outside with a micro insect pin No. 0 mounted on a rod. Pricking was done carefully so as not to injure the corn seedlings unduly. A lot of 12 corn seedlings treated similarly with another pin and with a healthy abacá leaf as source of inoculum was provided for control.

In this experiment three corn plants of the inoculated lot showed symptoms of mosaic infection on their leaves with respective incubation periods of 19, 26, and 42 days. These plants developed a mild form of mottling discernible on the leaves as pale yellowish areas interspersed with dark green. In one corn plant the incipient stage of the disease was indicated by the appearance of strings of pale white or yellowish dots clearly visible on the nether side of the leaf. These dots appeared on or along the midrib and on the lamina, arranged more or less in rows following the direction of the leaf veins (Pl. 1, fig. 3). The dots developed into short dashes and formed rows of apparently disconnected dashes or streaks. Mottling of a mild type developed later (Pl. 1, fig. 5), but these symptoms faded out gradually as the corn leaves advanced in age.

Experiment 2. Another experiment was performed on January 17, 1955. Eight young and healthy experimental corn seedlings and an equal number for control were used. In this test none of the

experimental and control corn seedlings became mosaicked after two months.

Experiment 3. From the same source of virus used in tests 1 and 2, fourteen corn seedlings were inoculated on January 22, 1955. They were checked by a control. In this experiment two corn plants became mosaicked with respective incubation periods of 16 and 19 days.

Experiment 4. From another mosaicked abacá plant as virus source, 10 healthy corn seedlings were inoculated on February 9, 1955. An equal number of plants were treated for control. In this test mosaic infection appeared only on one corn seedling of the experimental lot after 27 days. The other plants including those in the control lot remained healthy throughout.

Experiment 5. A replicate of experiment 4 was performed on February 16. Twelve experimental and 12 check plants were used. The results obtained were negative after two months.

Experiment 6. From February 25 to March 12, thirty-five other corn seedlings were used in mechanical transmission experiments. The inoculum was taken from the mosaicked plants used as virus source in experiments 4 and 5. Three plants in the inoculated lot became mosaicked. All check plants remained healthy even after two months.

Experiment 7. As only a small number of the inoculated corn plants became infected with mosaic in experiments 1 to 6, it was decided to check these results further. From the same virus source plant used in tests 1 to 3, twenty-six corn seedlings were inoculated on April 12, 1955. A lot of 26 other seedlings served as control. In this test three corn plants out of the 26 inoculated showed symptoms of mosaic infection with a range of incubation periods of 35 to 48 days.

Experiment 8. Of 37 corn seedlings used in a transmission experiment on May 19, 1955, one plant showed mosaic infection on June 11, or after an incubation period of 23 days. None of the 37 seedlings in the control lot developed mosaic.

In the preceding eight experiments, 13 out of 154 corn seedlings inoculated with abacá mosaic became infected with the disease. It appears that transmission of an abacá mosaic causing virus to corn by pin punctures has been secured. Various factors undoubtedly influenced the transfer of the virus inoculum from mosaicked abacá to corn by manual means.

It can be seen in the preceding experiments that the success or probability of transmission of abacá mosaic to corn is of a low degree. Birkeland (1936) points out that the pin-puncture and leaf-excising methods used in isolating strains of virus and in mechanically transferring inoculum to healthy plants are more or less comparable to insect transmission. Rawlins and Tompkins (1936) state that failure to regularly transmit viruses by mechanical method is traceable to the inability to produce very small openings in the host cells to permit the entry of virus without injuring the cells to such an extent as to render them unfavorable for virus multiplication. Even in insect transmission of viral infection, marked differences in the ability of aphids to transmit plant viruses have been reported (Watson and Roberts, 1939; Doncaster and Kassanis, 1946; Sylvester and Simons, 1951; Simons and Sylvester, 1953). Sylvester (1954) points out that vector efficiency in transmitting viruses is subject to wide variations.

Recovery of abacá mosaic virus from corn

The recovery of abacá mosaic virus from corn and its subsequent transfer to healthy abacá plants and reproduction of the disease thereon would constitute proof that such virus has been successfully communicated to corn by pin punctures. The experiments described below were conducted to verify this point.

Experiment 1. Six young and healthy abacá seedlings were used in a transmission test on January 13, 1955. To each abacá seedling were transferred 50 individuals of *Aphis maidis* which were reared on an artificially infected corn plant. Control abacá seedlings, each with an equal number of aphids from a healthy corn plant, were provided. The experimental and check plants were kept in the greenhouse for observation. In this test only one abacá plant showed symptoms of mosaic infection on March 9, or after an incubation period of 45 days.

Experiment 2. From February 1 to March 10, 1955, nine other abacá seedlings were similarly inoculated. Of this number, one became mosaicked on April 12 and another on April 30, after incubation periods of 71 and 51 days.

Experiment 3. From March 15 to 26, 1955, eight other abacá seedlings were used in virus recovery tests with *A. gossypii* as vector. Fifty aphids from a mosaicked corn plant were placed on each abacá seedling. Nonviruliferous aphids were transferred to the check

plants. Of the eight inoculated abacá plants three became mosaicked with respective incubation periods of 57, 64, and 53 days.

Experiment 4. *Aphis maidis* and *A. gossypii* were reared separately on abacá plants which became infected with mosaic in the virus recovery tests. These two species of aphids were used separately as vectors, and the mosaic virus was successfully communicated to corn seedlings and from them back to abacá. Four abacá plants out of five inoculated with *A. gossypii* as vector and two abacá seedlings out of six inoculated with *A. maidis* became mosaicked. The periods of incubation ranged from 45 to 70 days.

The results of the preceding experiments demonstrated the transmissibility of abacá mosaic virus to corn by mechanical inoculation. Although only a small number of the inoculated corn seedlings became infected with mosaic, the results seem conclusive as the virus was recovered from corn and proved to be still infectious to abacá.

It was observed, however, that the recovered mosaic virus induced on the abacá plants a mild form of mottling (Pl. 2, fig. 1). The symptoms consisted of a few, pale yellowish patches, elongate to almost spindlelike, scattered on the leaf lamina and lying parallel to the veins. The mottling effect did not increase noticeably in intensity on subsequent leaves (Pl. 2, fig. 2). As the leaves advanced in growth the symptoms decreased in intensity.

Complete masking or loss of symptoms of mild mosaic, however, was not observed early on any of the artificially infected abacá plants in the virus recovery tests. Suckers which were produced later by the diseased plants likewise exhibited a mild form of mosaic pattern on the leaves.

In contrast, however, infection of abacá seedling with mosaic of the severe type produced a distinct mottling on the leaves. In insect transmission experiments, this mottling appeared rather intense and conspicuous on the abacá leaf which followed in appearance on the same stem the first leaf that came out with the incipient stage of the mosaic disease (Pl. 2, figs. 3 and 4).

The mild form of mosaic obtained in virus recovery tests could not possibly be attributed to an attenuated form of abacá mosaic virus which is identified with the production of severe type of mottling. It has been shown earlier in insect transmission experiments that the virus of the severe form of abacá mosaic infected corn, and when recovered from this plant, it induced again on healthy abacá plants a severe type of mottling. Evidently, the virulence of this virus is not reduced by its passage through corn. Lackey (1932)

found that the virus of sugar beet curly top disease is attenuated by passing through a resistant host, *Chenopodium murale.* The virulence of the attenuated virus from *C. murale,* however, is restored by passing it through a susceptible host, *Stellaria media.*

The results obtained in the preceding experiments show the presence of a mild form of mosaic on the abacá plants used as virus source. This mild form of mosaic was separated from the severe form by transmission to corn by pinpricks.

The occurrence of mixed mosaic infections on some abacá plants in the field is highly probable. Diseased abacá plants in Davao commonly exhibit varying intensities of mosaic pattern. Whether this is due to infection by different viruses or not has not been investigated. Abacá plants, however, are exposed to infection by different viruses in the field. Based on field observation, Kent (1954) considers abacá mosaic to be a complex infection which involves several viruses or virus strains.

It is probable that the mild and severe forms of virus involved in the present study originated from different sources and infected abacá independently of each other. Abacá plants are susceptible to infection by *Canna indica* mosaic and strains of grass mosaic. It is conceivable too that a variant or a strain of virus from a virus already existing developed. According to Birkeland (1936), mutation appears to be a common occurrence in certain plant viruses, and mutants or variants can be isolated that stimulate the production of symptoms quite distinct from those induced by the parents. Jensen (1933) concluded that the viruses of yellow mosaic of tobacco arise during multiplication of tobacco mosaic virus in infected plants.

It was noted that early in the development of a mixed infection of the two mosaic viruses in artificially infected abacá plants, the symptoms produced by the virus of the severe type appeared more pronounced than those produced by the mild form. As the two diseases progressed, only the symptoms of the severe form of mosaic could be seen. Caldwell (1935) found that when a virus-infected plant is inoculated with a second virus, one type of reaction observed is characterized by multiplication of the two viruses and the production of symptoms typical of each disease. In other cases, however, a virus may completely inhibit the development of another in the host tissue.

Retransmission of mild mosaic

It is important to determine whether or not the mild form of mosaic will develop true to type. In two separate inoculation expe-

riments (May 27 and 30, 1955), 12 abacá seedlings were exposed to virus-bearing individuals of *A. gossypii.* A batch of 100 aphids from a culture of the insect on an abacá plant previously infected with mild mosaic was transferred to each seedling. A control was provided as usual. In these tests three abacá seedlings became infected and exhibited symptoms of mild mosaic. The periods of incubation ranged from 65 to 78 days.

On June 22 and 25, 1955, a total of 14 healthy abacá seedlings was similarly inoculated. *A. gossypii* used in these tests obtained the mosaic inoculum from the corn plants which were artificially infected with mild mosaic of abacá. Of the 14 plants used in transmission experiments, five showed mild mosaic with respective incubation periods of 43, 38, 50, 45, and 59 days.

In one additional set of experiments, corn seedlings were artificially infected with the mild mosaic of abacá by pinpricks. From the infected corn plants the virus was transmitted back to a healthy abacá seedling by *A. maidis.* Then, with this infected abacá plant as virus source, *A. gossypii* successfully transferred the virus to a healthy abacá seedling on June 28, 1955, and induced similar infection of mild mosaic on August 12, 1955.

The results show that the mild form of mosaic reproduced itself consistently on abacá plants in retransmission tests. The isolation of a virus distinct from that which causes a severe type of mosaic in abacá seems to have been obtained.

Reinoculation of abacá plant infected with the mild mosaic

One abacá plant with the mild mosaic was used as suscept in a transmission experiment on May 5, 1955. Fifty individuals of *A. gossypii* reared on abacá plants infected with severe mosaic were transferred and allowed to colonize on the shoot of an abacá plant with the mild mosaic. A healthy abacá seedling to which were transferred an equal number of aphids from the virus source was used as control or indicator. In this experiment both the experimental and the indicator abacá plants showed mosaic infection of the severe type.

Four other mild mosaic-infected abacá plants were similarly reinoculated on June 7, 1955, with the abacá mosaic virus of the severe type. Two healthy abacá plants treated likewise were used as indicators. In this test a mosaic infection with intense mottling was induced on all abacá plants. Owing to pronounced mottling

produced by the severe form of mosaic on the subsequent leaves, the mild form of mosaic became practically indiscernible on the lamina of the experimental plants.

This result furnishes additional evidence that the two viruses involved in this study are distinct from each other.

DISCUSSION OF RESULTS

The isolation of a virus which causes a mild form of mosaic on abacá points to the occurrence of an abacá mosaic complex. The need for further studies on the extent of this mixed mosaic infection in the field is imperative. Such studies will have an important bearing on the formulation of any program for the control of the disease.

The two identifiable abacá mosaic viruses considered in this study could be separated by selective inoculation, that is, by the pin-puncture method of transmission. With this method, only the virus of mild mosaic can be communicated to corn. The existence of other mixed plant viruses and their separation have been reported before. Tompkins (1939) separated the mild mosaic and the severe mosaic of annual stock or gilliflower (*Matthiola incena* R. Br. var. *annua*) in California by the use of differential host plants. Smith (1931) studied the composite nature of potato viruses of the mosaic group through the use of plant indicators and by selective methods of transmission. In a mixed infection of bunchy-top virus of abacá and abacá mosaic virus, either virus could be readily isolated from the mixture by the use of a specific aphid vector. The banana aphid, *Pentalonia nigronervosa* Coquerell, could pick up bunchy-top virus from diseased abacá, and *Aphis maidis* or *Aphis gossypii* could readily transmit mosaic virus, but not the bunchy-top virus, to healthy abacá (Ocfemia, Celino, Garcia, 1947).

The results obtained in the present study invariably show that one of the abacá mosaic viruses is transmissible to corn by needle pricks.

LITERATURE CITED

BIRKELAND, J. M. 1936. On the classification of plant viruses. Phytopath. 26: 456-458.

CALDWELL, J. 1935. On the interactions of two strains of a plant virus; experiments on induced immunity in plants. Proc. Roy. Soc. London, Ser. B, 117: 120-139.

CELINO, M. S. 1940. Experimental transmission of the mosaic of abaca or Manila hemp plant (*Musa textilis* Née). Philippine Agriculturist 29: 379-415.

CELINO, M. S., AND G. O. OCFEMIA. 1941 Two additional insect vectors of mosaic of abaca, or Manila hemp plant, and transmission of its virus to corn. Philippine Agriculturist **30**: 70-78.

DONCASTER, J. P., AND B. KASSANIS. 1946. The shallot aphis Myzus ascalonicus Doncaster and its behavior as a vector of plant viruses. Ann. Appl. Biol. **33**: 66-68.

JENSEN, J. H. 1933. Isolation of yellow mosaic viruses from plants infected with tobacco mosaic. Phytopath. **23**: 964-967.

JULIANO, J. P. 1951. A study of the mosaic disease of abaca, or Manila hemp (*Musa textilis* Née), with special reference to sources of inoculum and possible transmission of the virus by mechanical means. Philippine Agriculturist **34**: 125-132.

KENT, G. C. 1954. Abaca mosaic. Philippine Agriculturist **37**: 555-577.

LACKEY, C. F. 1932. Restoration of virulence of attenuated curly-top virus by passage through Stellaria media. Jour. Agric. Res. **44**: 755-765.

OCFEMIA, G. O. 1930. Bunchy-top of abacá or Manila hemp: I. A study of the cause of this disease and its methods of transmission. Amer. Jour. Bot. **17**: 1-18.

OCFEMIA, G. O., AND M. S. CELINO. 1938. Transmission of abacá mosaic. Philippine Agriculturist **27**: 593-598.

OCFEMIA, G. O., M. S. CELINO, AND F. J. GARCIA. 1947. Further studies on transmission of bunchy-top and mosaic of abacá (Manila hemp plant), separation of the two diseases and mechanics of inoculation by *Pentalonia nigronervosa* Coquerell. Philippine Agriculturist **31**: 87-97.

RAWLINS, T. E., AND C. M. TOMPKINS. 1936. Studies on the effect of carborundum as an abrasive in plant virus inoculations. Phytopath. **26**: 578-587.

SEIN, JR., FRANCISCO. 1930. A new mechanical method for artificially transmitting sugar cane mosaic. Jour. Dept. Agric. Puerto Rico **14**: 49-68.

SIMONS, J. N., AND E. S. SYLVESTER. 1953. Acquisition threshold period of western celery mosaic virus for four species of aphids. Phytopath. **43**: 29-31.

SMITH, K. M. 1931. On the composite nature of certain potato viruses of the mosaic group as revealed by the use of plant indicators and selective methods of transmission. Proc. Roy. Soc. London, Ser. B, **109**: 251-267.

SYLVESTER, E. S. 1954. Aphid transmission of non-persistent plant viruses with special reference to the Brassica nigra viruses. Hilgardia **23**: 53-98.

SYLVESTER, E. S., AND J. N. SIMONS. 1951. Relation of plant species inoculated to efficiency of aphids in the transmission of Brassica nigra virus. Phytopath. **41**: 908-910.

TOMPKINS, C. M. 1939. Two mosaic diseases of annual stock. Jour. Agric. Res. **58**: 63-77.

WATSON, M. A., AND F. M. ROBERTS. 1939. A comparative study of the transmission of Hyocyamus virus 3, potato virus Y, and cucumber virus 1 by vectors Myzus persicae (Sultz.), M. circumflexus (Buckton), and Macrosiphum gei (Koch). Proc. Roy. Soc. London, Ser. B., **127**: 543-576.

Plate 1

Fig. 1.—Portion of a leaf of a mosaicked abacá plant from Davao, Mindanao, showing the characteristic form of severe mottling.

Fig. 2.—A leaf of a mosaicked abacá plant inoculated with virus recovered by *A. gossypii* from corn artificially infected with severe form of abacá mosaic in insect transmission experiment. Note the severe form of mottling. Compare with figure 1.

Fig. 3.—Portion of a leaf of a corn plant showing the symptoms produced by abacá mosaic virus in mechanical transmission experiment.

Fig. 4.—Portion of a healthy leaf.

Fig. 5.—Upper portion of a corn plant showing symptoms (mottling) due to artificial inoculation with abacá mosaic by pinpricks.

Plate 2

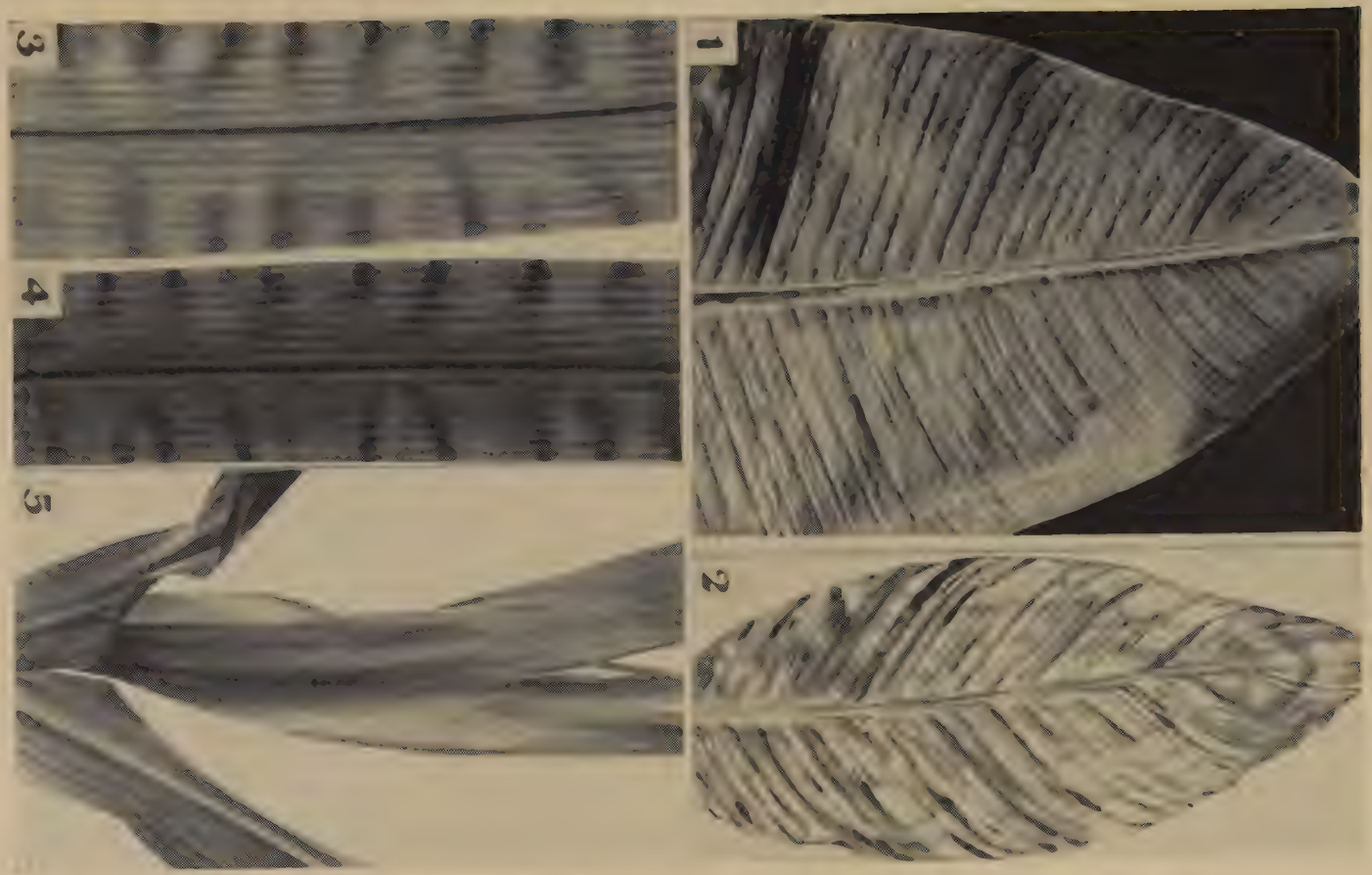
Fig. 1.—An expanded leaf of an abacá seedling inoculated with the strain of virus recovered by *A. gossypii* from corn which was artificially infected with abacá mosaic by needle pricks. Note the mild form of mosaic pattern.

Fig. 2.—A portion of a leaf produced subsequently by the abacá plant mentioned in figure 1. This leaf, the sixth produced by the plant after the leaf shown in figure 1 was photographed, showed also a mild form of mosaic. Compare with figures 1 and 2 of Plate 1.

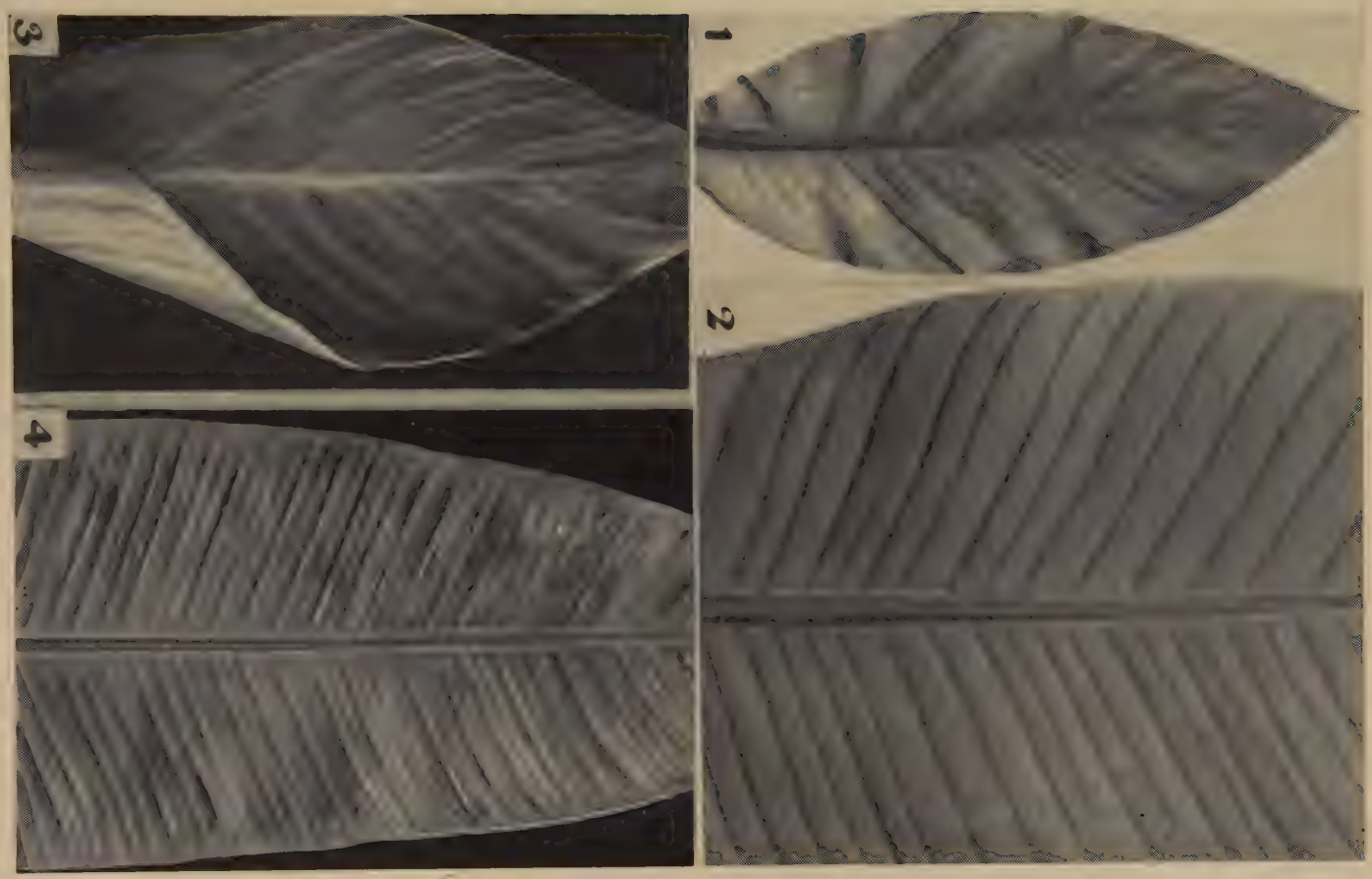
Fig. 3.—A partially expanded leaf of an abacá seedling showing the earliest symptoms of a severe mosaic infection obtained in insect transmission experiment.

Fig. 4.—This leaf followed in appearance on the same stem the leaf shown in figure 3. Note the severe type of mosaic symptoms.

(*Photographed by the Photographic Division.*)



CELINO AND MARTINEZ: MECHANICAL TRANSMISSION OF MOSAIC VIRUS FROM ABACA TO COCO



CHING AND MARTINEZ: MECHANICAL TRANSMISSION OF MOSAIC VIRUS FROM ABACA TO CORN

PROPAGATION OF VANILLA BY CUTTINGS [1]

JOSE R. MONDOÑEDO, FELIX A. RAMILO, PEDRO D. SANGATANAN, AND DEMOCRITO K. TALIAN

WITH THREE TEXT FIGURES

Vanilla cuttings regardless of length can be stored before planting for at least three weeks without deteriorating. Four months after planting, 1-meter cuttings produced better growth than shorter cuttings. Use of mulch did not improve the growth of newly planted cuttings. Burying one-fourth the length of 1-meter cuttings in the soil produced better growth than planting cuttings deeper. Grown under less than 50 per cent shade, cuttings became yellowish and stunted.

Vanilla planifolia Andr., often referred to as the orchid of commerce, is a very new commercial crop in the Philippines. Because of the increased demand for its products for flavoring and perfumes, farmers are becoming more conscious of its importance as a crop that can increase their income.

Although vanilla can be propagated by seeds, it is easily and cheaply multiplied by cuttings. To give the cuttings a good start in the field, the conditions to which cuttings will respond most favorably must be determined. Among the factors yet undetermined are shade requirements, length of cutting, depth of planting, and suitable media. It is also important to know how long cuttings can stand storage in transit before they are planted. A study of these factors was conducted from April, 1954, to March, 1955, in the Department of Agronomy.

MATERIALS AND METHODS

Three separate experiments were run concurrently. However, some of the operations involved were the same. All cuttings were obtained from the middle of healthy vines of uniform size. Before planting, all visible aerial roots were cut off to facilitate more accurate measurements and to start the cuttings on a common basis since broken roots cannot be avoided in the process of gathering the cuttings. For commercial planting, however, roots need not be removed.

Leaves from the nodes of the cuttings that would be covered by the media were cut off. All plantings were made in pots 27 centi-

[1] Central Experiment Station Contribution No. 1859.

meters in diameter and 23 centimeters in height. The vine in each pot had a madre de cacao branch for support. The media were kept moist by frequent watering during the experiment, but water logging was avoided.

Records were kept of the following:

1. Date of emergence of first shoot.
2. Date of emergence of first aerial root.
3. Total number and total growth of shoots.
4. Total number and total growth of aerial roots.
5. Total number and total growth of terrestrial roots.
6. Mortality and incidence of pests and diseases.
7. General vigor of the plants.

Only the results at the end of the experimental period are presented in the tables although observations were made throughout the experiments.

Storage and length of cutting experiment. Six-, eight-, ten-, and twelve-node cuttings were prepared and wrapped in banana bracts one, two, and three weeks before planting. Including the control which was not stored, a total of 64 cuttings was used, four cuttings to a treatment combination. All cuttings were planted on the same day, two to three nodes deep in ordinary garden soil. A thin layer of mulch was provided. All the pots were placed under partial shade.

Media and depth of planting experiment. Garden soil alone, rice straw mulch alone, and garden soil-straw mulch combination in equal proportions by volume were the media used. The experiment was started with five cuttings to a treatment combination, but because of a disease which attacked the cuttings, only four to a treatment combination were finally analyzed. The newly planted cuttings were placed under partial shade.

Shade requirement experiment. Of 50 cuttings 1 meter long, 10 cuttings each were placed under full shade, three-fourths shade, one-half shade, and no shade. Lath houses of bamboo were constructed to provide the different degrees of shade. Cuttings were planted two to three nodes deep in ordinary garden soil with a thin layer of mulch on top.

RESULTS AND DISCUSSION

Influence of length of storage on growth. Shoots as well as aerial roots appeared earlier on cuttings prepared weeks ahead of

time than on those planted right away (table 1). The cuttings must have started growing while in storage. When the length of time it took the shoots to appear from the time of preparation of cutting was compared with that from the time of planting, the widest difference was only six days.

TABLE 1.—*Influence of length of storage on growth of vanilla cuttings*

GROWTH MEASUREMENT	LENGTH OF STORAGE				SMD .05
	Control	1 week	2 weeks	3 weeks	
No. of days from planting to appearance of first shoot	34.9	22.5	20.3	14.8	Not computed
No. of days from preparation of cutting to appearance of first shoot	34.9	29.5	34.3	35.8	Not computed
Total growth of shoots to a cutting 4 months after planting, in cm.	82.8	95.3	117.3	125.9	18.9
Total growth of aerial roots to a cutting 4 months after planting, in cm.	102.3	135.7	172.1	219.3	87.8
Total growth of terrestrial roots to a cutting 4 months after planting, in cm.	87.2	64.5	70.5	66.7	19.0
Percentage mortality 4 months after planting	5.0 [a]	12.5 [a]	5.0 [a]	none	Not computed

[a] Mortality due to *Pellicularia rolfsii* (Curzi) West.

For the same reason, shoot growth and aerial root growth were much longer in cuttings stored longer than in those stored for a shorter length of time (fig. 1). The vanilla vine is an epiphyte and can continue growing for some time without benefit of soil if given the proper moisture conditions. Cuttings planted right away showed better terrestrial root growth than stored cuttings. Storage had no significant effect on mortality. It is possible then to ship cuttings to far places without loss of viability.

According to McClelland,[2] it does not make much difference whether cuttings are planted immediately or allowed to wilt for 12 to 15 days. He observed, however, that if leaves are left on the cuttings, thus avoiding much injury, and the basal end of the vine is

[2] T. B. McClelland, *Puerto Rico Agric. Exper. Sta. Bull.*, 26 (1919).

Fig. 1.—Growth of vanilla cuttings 4 months after planting. I—6-node cuttings, II—8-node cuttings, III—10-node cuttings, IV—12-node cuttings; A—not stored, B—1-week storage, C—2-week storage, D—3-week storage.

left exposed to the air to heal over, the cutting usually escapes rot and other diseases. Childers and Cibes [3] reported that vanilla cuttings need not be planted immediately, but should be planted within two to three weeks after being prepared. They also reported that two- to twelve-node cuttings may be used.

Influence of length of cutting on growth. The length of the cuttings for propagation has a decided influence on their subsequent growth (table 2). Longer cuttings produced longer shoots, more and longer aerial roots, and more and longer terrestrial roots than shorter cuttings (fig. 1). This was expected because the longer cuttings had more leaves and therefore had a greater capacity for plant food synthesis. The result then was an increase in the growth of the plants including roots and shoots. An increase in root growth means a greater intake of raw materials. One would expect more aerial roots in longer cuttings because of the presence of more nodes from which aerial roots develop. This experiment also shows that short cuttings can be used if there is a shortage of planting materials.

TABLE 2.—*Influence of length of vanilla cutting on subsequent growth*

GROWTH MEASUREMENT	LENGTH OF CUTTING				SMD .05
	6 nodes	8 nodes	10 nodes	12 nodes	
No. of days from planting to appearance of first shoot	30.1	18.8	19.4	23.1	Not computed
No. of days from preparation of cutting to appearance of first shoot	41.5	29.4	29.9	33.7	Not computed
Total growth of shoots to a cutting 4 months after planting, in cm.	68.8	117.5	108.7	126.2	18.9
Total growth of aerial roots to a cutting 4 months after planting, in cm.	74.7	135.9	204.8	214.0	87.8
Total growth of terrestrial roots to a cutting 4 months after planting, in cm.	45.0	78.3	76.7	89.0	19.0
Percentage mortality 4 months after planting	5.0 [a]	none	175.5 [a]	none	Not computed

[a] Mortality due to *Pellicularia rolfsii* (Curzi) West.

[3] Norman F. Childers and Hector R. Cibes, *Fed. Exper. Sta. in Puerto Rico Cir.*, 28 (1948).

David [4] recommends the use of 1-meter cuttings prepared from any part of healthy vines for commercial preparation. Correll [5] observed in Mexico, however, that the common practice is to use 1-foot-long cuttings; in some regions 6- to 12-foot cuttings are used.

Influence of depth of planting on growth. Table 3 and figure 2 show that planting 1-meter-long cuttings with three-fourths of their length exposed produced greater growth of shoots, aerial roots, and terrestrial roots than planting cuttings with one-half or one-fourth of their length exposed. Cuttings planted deeper have less leaves exposed; hence, their capacity for food synthesis is not as great as the cuttings planted shallower.

TABLE 3.—*Influence of length of vanilla cutting buried on subsequent growth*

GROWTH MEASUREMENT	LENGTH BURIED			SMD .05
	25 cm.	50 cm.	75 cm.	
No. of days from planting to appearance of first shoot	43.6	30.3	29.7	Not computed
Total growth of shoots to a cutting 6 months after planting, in cm.	127.2	108.6	84.3	Not significant
Total growth of aerial roots to a cutting 6 months after planting, in cm.	172.0	133.8	74.5	48.8
Total growth of terrestrial roots to a cutting 6 months after planting, in cm.	142.3	123.5	70.3	48.4
Percentage mortality at 6 months	6.7	20.0	20.0	Not computed

[a] Mortality due to *Pellicularia rolfsii* (Curzi) West.

The early emergence of aerial roots and shoots in the cuttings planted shallow may have contributed to the better growth of shoots and roots. Mortality was more in the 50 and the 70 centimeters depth of planting than in the 25 centimeters depth. Death of the cuttings was due to *Pellicularia rolfsii* (Curzi) West (*Sclerotium rolfsii* Sacc.).[6]

Influence of medium on growth. Soil alone as cover for the vanilla cuttings gave the best results (table 4). Not only did it entail less labor and expense but it produced better growth than mulch

[4] Pedro A. David, *Philippine Agriculturist*, 33, 239 (1950).
[5] Donavan S. Correll, *Econ. Bot.*, 7, 291 (1953).
[6] Identified by Dr. Faustino T. Ocfemia of the Department of Plant Pathology.

Fig. 2.—Growth of vanilla cuttings 6 months after planting. I—25 centimeters depth, II—50 centimeters depth, III—75 centimeters depth; A—soil cover, B—mulch cover, C—soil-mulch combination.

or soil-mulch combination. This may be explained by the fact that plant food is available from the mulch only after its decomposition. For the same reason, the soil-mulch combination did not do well. Less raw materials are available to the plants in mulch alone and in soil-mulch combination than in soil alone at least for the initial growth.

TABLE 4.—*Influence of medium on growth of vanilla cuttings*

GROWTH MEASUREMENT	MEDIUM			SMD .05
	Soil	Mulch	Soil-Mulch	
No. of days from planting to appearance of first shoot	29.3	54.8	28.4	Not computed
Total growth of shoots to a cutting 6 months after planting, in cm.	128.5	84.7	102.0	Not significant
Total growth of aerial roots to a cutting 6 months after planting, in cm.	142.4	105.7	132.3	43.8
Total growth of terrestrial roots to a cutting 6 months after planting, in cm.	145.2	117.6	73.2	48.4
Percentage mortality at 6 months	13.3 [a]	20.0 [a]	13.3 [a]	Not computed

[a] Mortality due to *Pellicularia rolfsii* (Curzi) West.

In addition, the advantage of mulch with regard to moisture conservation was nullified because the pots were watered often. In the field, however, where the crop is almost solely dependent on rain, the use of mulch would be most advantageous. This has been observed in the already established College vanilla plantation. Aside from the moisture conserved, organic matter is added to the soil.

One disadvantage of mulching is the possible introduction of pests and diseases to the plantation through the mulch. This did not show, however, in this experiment.

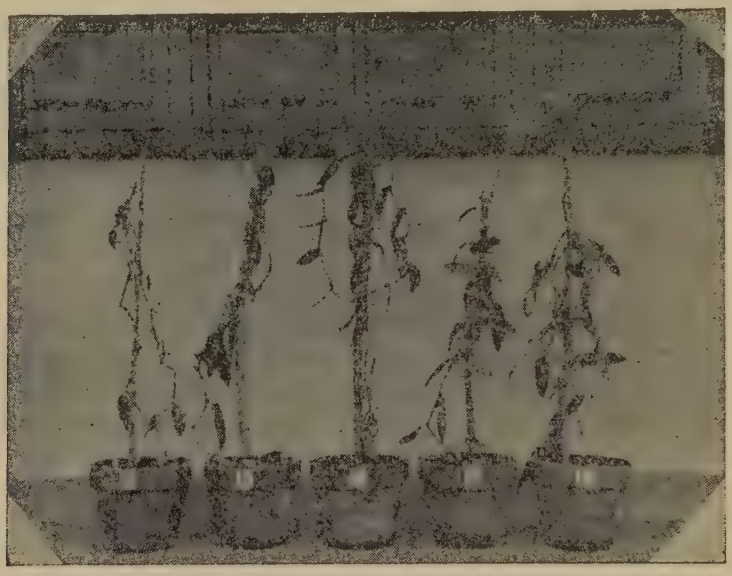


Fig. 3.—Growth of vanilla cuttings 5 months after planting. A—no shade, B—¼ shade, C—½ shade, D—¾ shade, and E—full shade.

Influence of shade on growth. It is very evident from the results obtained that enough shade must be provided vanilla cuttings (table 5). At least one-half of the sun's rays must be blocked off to get good root and shoot growth. Aside from their longer length, the half-shaded cuttings had longer nodes, thicker stems, and greener and broader leaves than the cuttings under very little or no shade. Unshaded vines were yellowish and had symptoms of sun scald (fig. 3). Mortality was high in cuttings grown under full shade, three-fourths shade, and no shade. Cause of death was *Pellicularia rolfsii* (Curzi) West. It is probable that in heavy shade, atmos-

pheric and soil conditions were most suitable for the disease organism. Unshaded plants, on the other hand, were in such poor condition that they readily succumbed to the disease.

TABLE 5.—*Influence of shade on growth of vanilla cuttings*

GROWTH MEASUREMENT	SHADE PROVIDED					SMD .05
	No shade	¼	½	¾	Full	
No. of days from planting to appearance of first shoot	34.9	27.2	26.5	20.2	23.8	Not significant
Total growth of shoots to a cutting 5 months after planting, in cm.	87.0	113.5	131.1	103.5	146.9	Not significant
Total growth of aerial roots to a cutting 5 months after planting, in cm.	3.7	4.9	6.9	5.2	9.4	1.3
Total growth of terrestrial roots to a cutting 5 months after planting, in cm.	25.4	31.8	27.8	33.0	30.4	Not significant
Percentage mortality at 5 months after planting	30.0[a]	none	none	30.0[a]	20.0[a]	Not computed

[a] Mortality due to *Pellicularia rolfsii* (Curzi) West.

The optimum amount of sunlight for good growth of vanilla cuttings found by Hernandez [7] in Puerto Rico is one-half of full sunlight.

CONCLUSIONS

It appears from this experiment that for best propagating results, 1-meter-long cuttings should be planted with one-fourth of their length covered with soil and provided with at least 50 per cent shade. Mulch may prove advantageous under field conditions and after decomposition. It is not necessary that cuttings be planted right away. After three weeks of storage they are still good.

[7] M. E. Hernandez, *Puerto Rico Univ. Jour. Agric.*, 27 (1943).

ACONITIC ACID CONTENT OF SUGAR CANE JUICE AND LEAVES AND CANE FINAL MOLASSES[1]

BIENVENIDO O. JULIANO

Chromatographic analysis showed that the aconitic acid content of leaves of College 39 canes decreased with the age of the leaf, but remained unaffected by the age of the cane. Aconitic acid in the leaves constituted 0.80 to 2.33 per cent of the dry weight.

Juice from mature canes of varieties Alunan, Hawaii 44-3098, and College 39 contained aconitic acid ranging from 0.44 to 2.07 per cent of the dry solids and from 809 to 3,799 milligrams per liter. Two samples of final molasses from Canlubang Sugar Central contained 2.17 per cent and 3.64 per cent aconitic acid, based on Brix solids. The actual amount of this acid in the juice and molasses is believed higher than these figures obtained by chromatographic analysis after alcoholic fermentation of the samples. In control experiments with pure aconitic acid-sucrose solution, about 83 per cent of the aconitic acid was recovered by this procedure.

One of the pressing problems confronting the Philippine sugar industry is overproduction. To bolster the industry, commercial utilization of some by-products has been suggested in a recent sugar convention. Aconitic acid production merits consideration because of the industrial uses of the acid, the feasibility of its commercial production, and the availability of raw materials.

This study presents preliminary information on the quantities of aconitic acid in the leaves and juice of some local sugar cane varieties and in the final molasses. This work was done from April to October, 1955.

MATERIALS AND METHODS

Analysis of cane leaves. To determine the relation of age of the leaves to their aconitic acid content, leaf samples consisting of leaf blades and sheaths from mature and immature College 39 canes were collected. The maturity of the canes was ascertained by comparing refractometer solids of the juice from the top, middle, and bottom portions of the stalk. Immediately after, they were cut into small pieces and dried in the oven at 80°C. for 24 hours. The dried samples were ground in the Wiley mill and stored in the desiccator.

[1] Central Experiment Station Contribution No. 1860. Thesis presented for graduation, October, 1955, with the degree of Bachelor of Science in Agriculture. Prepared in the Department of Agricultural Chemistry under the direction of Associate Professor Leopoldo J. Villanueva and Assistant Professor Apolinario R. Carangal, Jr.

The dry weight of the samples was determined by drying 0.5 gram of the ground samples to constant weight at 100 to 105°C.

Organic acid fractions for chromatographic analysis were prepared by ether extraction of the acidified dried samples.

The aconitic acid was separated from the other acids according to the chromatographic procedure of Bulen, Varner, and Burrell (1952). The fractions corresponding to aconitic acid were titrated with 0.01N NaOH to determine its amount. Results were expressed in percentage of the dry weight.

All aconitic acid fractions were collected after titration and isolated as calcium magnesium aconitate. This was reconverted to the free acid and identified chemically.

Analysis of cane juice and final molasses. A high concentration of sugars in the sample was found to interfere in the chromatographic procedure of Bulen *et al.* (1952). The juice and final molasses were hard to dry because of their high sugar content. Alcoholic fermentation of the sample was resorted to in order to destroy the sugars before chromatographic analysis of such samples. In control experiments using pure aconitic acid-sucrose solution, an average of 83.2 per cent of the aconitic acid was recovered by alcoholic fermentation and subsequent chromatographic analysis.

Mature cane stalks of three sugar cane varieties (Alunan, Hawaii 44-3098, and College 39) were collected. Maturity of the canes was ascertained by comparing refractometer solids of the juice of the top, middle, and bottom portions of the stalks. Portions of known volume of each juice sample were fermented after ammonium sulfate, primary calcium phosphate, and dehydrated Fleischmann's yeast pellets were added. Dry solids of the samples were determined.

Two samples of final molasses from the Canlubang Sugar Estate were fermented to isolate the aconitic acid. The specific gravity and Brix solids of the molasses were determined. Dilute molasses solution samples were fermented after the addition of the same ingredients as in cane juice samples.

After a three-day fermentation period, the samples were acidified, heated to boiling until foaming ceased, and filtered while hot. After thorough washing, the filtrate was concentrated and dried on a sand bath. Such drying under a highly acidic condition removed a great portion of the acetic acid formed during fermentation. These dried samples were used as the organic acid fractions.

The aconitic acid was separated and determined in the same manner as the acid fraction of the leaves. Results were expressed in milligrams of acid per liter of sample and in per cent of the dry or Brix solids.

Identification of aconitic acid. The collected fractions were concentrated and tested for aconitic acid according to the method of Taylor (1919). The concentrated sodium aconitate was acidified with HCl. The aconitic acid was then precipitated as calcium magnesium aconitate, after pH adjustment to 7 with lime and after subsequent addition of solutions of calcium and magnesium chlorides at 100°C. The precipitate was collected by filtration, dried, and tested for aconitate ion, after the method of Taylor (1919) as employed by McCalip and Seibert (1941).

RESULTS AND DISCUSSION

The analysis of the leaf samples from College 39 canes showed that age of the leaf had a significant effect on its aconitic acid con-

TABLE 1.—*Aconitic acid content of leaves of mature and immature College 39 sugar cane*

SAMPLE	PERCENTAGE OF ACONITIC ACID [a]			MEAN
	Outer leaves	Middle leaves	Shoot	
Mature canes				
1	0.80	1.25	1.57	
2	1.10	1.43	1.65	
3	1.33	1.54	2.01	
4	1.54	1.63	2.08	1.49
Immature canes				
1	1.84	2.33	2.16	
2	0.90	1.40	1.40	
3	1.75	1.94	1.82	
4	1.29	1.59	1.76	1.68
Mean	1.32	1.64	1.81	

[a] Dry basis, average of two determinations.

Analysis of variance

SOURCE OF VARIANCE	DF	SS	MS	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Age (A)	1	0.211	0.211	1.99	4.35	8.10
Position (P)	2	0.982	0.491	4.63 [a]	3.49	5.85
Pooled error	20	2.117	0.106			
Total	23	3.310				

[a] Significant.

SMD at 5% (P) = 0.33

tent. The shoot had a significantly higher aconitic acid content than the outer leaves (table 1). The aconitic acid content of the leaves was not affected by the age of the cane. It ranged from 0.80 to 2.33 per cent of the dry weight of the leaf.

Aconitic acid content of the juice samples ranged from 0.44 to 2.07 per cent of the juice solids and from 809 to 3,799 milligrams per liter of juice (table 2). These values would be higher if corrections were made for the loss of aconitic acid during fermentation and chromatographic analysis.

TABLE 2.—*Average aconitic acid content of juice and final molasses of different sugar cane varieties* [a]

SAMPLE	ACONITIC ACID CONCENTRATION	
	Mg./liter	Percentage of solids [b]
Sugar cane juice		
Variety Alunan		
1	1231	0.66
2	1507	0.87
3	809	0.44
4	1126	0.88
Variety Hawaii 44–3098		
1	3799	1.75
2	1868	0.95
3	1398	0.76
4	2030	1.03
Variety College 39		
1	1904	1.29
2	1136	0.57
3	1048	0.44
4	3166	2.07
Cane final molasses (Canlubang)		
Sample 1	25,148	2.17
Sample 2	42,790	3.64

[a] Based on 3 trials.
[b] Based on dry solids for juice and Brix solids for molasses.

Balch *et al.* (1946) reported that aconitic acid constituted 0.3 to 1.6 per cent of Louisiana cane juice Brix solids. Honig (1953) found the average aconitic acid content of Louisiana cane to be approximately 1,500 milligrams per liter of juice. In the juice of the three varieties of cane, the concentration of aconitic acid averaged 1,750 milligrams per liter, indicating a relatively higher concentration of the acid in the samples even without corrections for the loss of the acid during fermentation.

According to Haines and Joyner (1955), leaves of sugar cane have a much higher aconitic acid content than the stalk, but this source has never been tapped because of collection and juice extraction problems. Since aconitate is recovered as a by-product from raw sugar production, cane leaves have been ignored, inasmuch as their juice is low in sucrose and of little importance for sugar recovery. Balch, Broeg, and Ambler (1945) found the sheaths and blades of Louisiana canes to contain three to five times as much aconitic acid as the millable canes. These results were based on percentage acid of the juice from the materials analyzed. Based on dry weight, the aconitic acid content of the leaves of mature College 39 canes appears to be the same as that of its juice.

Final molasses samples had aconitic acid concentrations of 2.17 per cent and 3.64 per cent of the Brix solids (table 2). These values, even without correction for the loss of the acid during fermentation, are within the range reported by other workers. Louisiana molasses solids were analyzed to be 1 to 6 per cent aconitic acid (Balch *et al.*, 1945). Analysis of composites of molasses from 26 factories located throughout the sugar belt of Louisiana revealed its presence in amounts ranging from 3.3 to as much as 7.0 per cent of the dry solids, with an average of 4.97 per cent (Fort *et al.*, 1952). McCalip and Seibert (1941) found two samples of final molasses to contain 1.80 and 2.52 per cent aconitic acid. Further investigations should be made on the aconitic acid content of final molasses from different sugar centrals in the Philippines.

Taylor's test proved that the acid collected was aconitic acid.

A correction factor will have to be worked out in a later study as a result of the fermentation procedure found necessary to obtain reasonably high recoveries of the acid from cane juice and final molasses by chromatographic analysis.

LITERATURE CITED

BALCH, R. T., C. B. BROEG, AND J. A. AMBLER. 1945. Aconitic acid in sugar cane products. Sugar **40** (10): 32-34.

————. 1946. Aconitic acid in sugar products. Internat. Sugar Jour. **48**: 186-188. *Cited in* Long, Jr., L. 1949. Sugar and sugar by-products in the plastics industry. Sugar Res. Foundation, Inc., Technological Rept. 5: 36-39.

BULEN, W. A., J. E. VARNER, AND R. C. BURRELL. 1952. Separation of organic acids from plant tissues. Analyt. Chem. **34**: 187-190.

FORT, C. A., B. A. SMITH, C. L. BLACK, AND L. F. MARTIN. 1952. Aconitic acid content and composition of Louisiana black-strap molasses. Sugar 47 (10): 33-35.

HAINES, JR., H. W., AND L. G. JOYNER. 1955. Calcium magnesium aconitate. Industrial Engineer. Chem. 47: 178-186.

HONIG, P. (ed.). 1953. Principles of sugar technology. xxii + 767 p. Amsterdam: Elsevier Publishing Co.

MCCALIP, M. A., AND A. H. SEIBERT. 1941. Aconitic acid from sugar cane products. Industrial Engineer. Chem. 33: 637-640.

TAYLOR, C. S. 1919. The presence of aconitic in sugar-cane juice and a new reaction for the detection of the acid. Jour. Chem. Soc. 115: 886-889.

THE FIRST-YEAR LAYING PERFORMANCE OF S.C. WHITE LEGHORN PULLETS BROODED AND REARED ON ANTIBIOTIC-SUPPLEMENTED RATIONS [1]

FELICITAS L. CORTES

The College all-mash brooding and rearing rations which were supplemented with ½ per cent Aurofac hastened the sexual maturity of birds but did not significantly increase the annual percentage of egg production. The eggs produced in the experimental lot were smaller than those in the control. The Aurofac-raised pullets had a higher rate of mortality than the control.

The feeding of antibiotics to poultry has been shown to improve the rate of growth and livability of chicks and the hatchability of eggs. Information regarding the aftereffects of antibiotic feeding on the first-year laying performance of young pullets, however, is still limited.

Sizemore and others reported that the addition of aureomycin to the diet of chicks up to their pullet age had no effect on their sexual maturity and did not improve their subsequent egg production.[2] Carpenter and Duckworth observed that adding antibiotic in the form of 0.25 per cent Aurofac to the diet of chicks during the rearing period did not improve their first-year laying performance.[3] The same authors likewise found that sexual maturity was not advanced by the accelerated growth rate caused by antibiotic-supplemented feed.

Mcdonald and McClymont found that penicillin, potassium penicillin, and procaine penicillin, when supplemented to the diet of young pullets from their rearing period up to their 36th week, did not appreciably affect sexual maturity and egg performance.[4]

To determine the residual effects of Aurofac upon the first-year laying performance of young pullets fed with the antibiotic up to

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[1] Central Experiment Station Contribution No. 1861. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, March, 1955. Prepared in the Department of Animal Husbandry under the direction of Research Professor Francisco M. Fronda.

[2] J. R. Sizemore, R. J. Lillie, C. A. Denton, and H. R. Bird, *Poultry Sci.*, 32, 618 (1953).

[3] K. J. Carpenter and J. Duckworth, *Nature (London)*, 169, 669 (1952).

[4] M. Mcdonald and G. L. McClymont, *Agric. Gaz. N.S. Wales*, 64, 420 (1953).

24 weeks of age, this study was conducted from January, 1954, to December, 1954.

MATERIALS AND METHODS

Sixty selected 24-week-old S.C. White Leghorn pullets were divided into two lots of 30 birds each. Lot I (experimental) consisted of pullets that had been fed with a ration containing 0.5 per cent Aurofac for every 100 kilograms of mash from their first day to their 24th week. Lot II (control) was composed of pullets raised on a similar ration but without the Aurofac supplement. At the start of the experiment, all the birds in both lots were wingbanded and weighed and then kept in individual laying cages inside a big poultry laying house.

Both lots were given the College standard laying mash ration consisting of the following ingredients, all parts by weight: ground corn, 50; rice bran, 20; copra meal, 10; fish meal, 20. Five kilograms of ground shells and grit and 1 kilogram of common table salt were added to every 100 kilograms of the mash. Chopped, fresh ipil-ipil leaves were given to the birds in both lots three times a week. Water was made available to them at all times. Both lots were given the same care and management.

The individual monthly weights of the birds and the egg production of the two lots were recorded. Eggs were collected every day and weighed on the lot basis. Likewise, the monthly feed consumption of each lot and the number of deaths in each were taken.

RESULTS AND DISCUSSION

Weight of birds. The average initial weight of lot I was 1.54 kilograms, whereas that of lot II was 1.30 kilograms. The difference was mainly due to the Aurofac supplement in lot I. Salinas noted that Aurofac-fed pullets raised up to 24 weeks of age gained more weight than the control birds.[5]

Since the pullets used were not yet fully grown at the start of the study, they were all expected to put on additional weight during the experimental period. However, the difference in monthly average weight between the experimental and the control birds was slight.

During September and October, the birds in both lots exhibited a very marked decrease in average weight, which may be attributed mainly to the very poor quality of fish meal in their rations during

[5] F. C. Salinas, *Philippine Agriculturist*, 38, 465 (1954).

this period. When a better quality fish meal was given to the birds the following month, they gradually recovered.

Lot I birds were consistently heavier than the control birds throughout the experiment. At the end of the experiment, the average weight of the birds in lot I was 1.87 kilograms, and that of lot II, 1.67 kilograms. The difference between the two lots was significant. Likewise, the mean of the monthly average weights in lot I (1.60 kg.) was also significantly greater than that in lot II (1.44 kg.).

Egg production. At the start of the experiment, the percentage egg production of lot I was 65.7, and that of lot II, 31.1 (table 1). This great difference was probably due to the presence of more sexually mature birds in the experimental than in the control lot. This result was similar to that obtained by Sugon who observed that the Aurofac-fed pullets attained their sexual maturity earlier than the control birds.[6] However, these findings do not conform to those reported by Carpenter and Duckworth [7]

TABLE 1.—*Distribution of egg production*

PERIOD	PERCENTAGE OF PRODUCTION	
	Lot I	Lot II
January 8–February 7, 1954	65.7	31.1
February 8–March 7	72.6	73.0
March 8–April 7	74.1	71.7
April 8–May 7	69.1	65.4
May 8–June 7	64.0	62.5
June 8–July 7	62.6	60.5
July 8–August 7	48.9	41.7
August 8–September 7	34.4	32.5
September 8–October 7	15.3	11.0
October 8–November 7	1.7	2.1
November 8–December 7	14.4	14.5
December 8–January 7, 1955	41.8	43.2
Total production for the year	4,603	4,487
Annual percentage of egg production [a]	49.9	42.7
Annual production to a bird, number	182.1	155.9
Average number of birds during the year	25.3	28.8

[a] Mean annual per cent difference not significant.

[6] Q. M. Sugon, *Philippine Agriculturist*, 39, 205 (1955).
[7] Carpenter and Duckworth, *op. cit.*

During the second month of the study, the birds in lot II had a slightly higher rate of production (73.0 per cent) than those in lot I (72.6 per cent), but from the third month up to the end of the experiment, the percentage of egg production of the two lots did not differ markedly. The maximum production in both lots was reached in February and March. After this period, the egg production declined gradually until the birds showed their nomal molt from June to August. During September, October, and the early part of November, the percentage of egg production went down to only 1.7 per cent in lot I and 2.1 per cent in lot II. This might have been due to the inferior fish meal mentioned before.

At the close of the experiment, lot I maintained the lead in egg production with 4,603 eggs, or an annual percentage of 49.9; lot II produced 4,487 eggs, or 42.7 per cent. On the individual basis, the annual egg production in lot I was 182.1, and that in lot II, 155.9. The trend suggests the beneficial effects of Aurofac feeding on the subsequent first-laying performance of young pullets. However, the mean annual percentage difference between the two lots was not significant.

Weight of eggs. At the start of the experiment, lot I eggs had an average weight of 45.4 grams, and lot II eggs, 46.2 grams (table 2). During the later part of the laying period, the size of the eggs

TABLE 2.—*Monthly average weight in grams of eggs laid during the year*

PERIOD	LOT I		LOT II	
	Number of eggs weighed	Weight of egg	Number of eggs weighed	Weight of egg
January	611	45.4	289	46.2
February	610	49.0	613	49.4
March	672	51.0	667	51.4
April	594	51.4	587	51.4
May	536	52.5	562	52.3
June	486	53.3	518	53.6
July	364	53.1	362	54.9
August	255	54.6	282	56.7
September	101	53.1	92	56.7
October	11	53.4	18	56.2
November	91	57.7	122	60.1
December	272	59.1	375	60.5
Annual	4,603		4,487	
Mean [a]		51.5		52.9

[a] Based on monthly means. Mean difference significant.

laid increased. This increase was expected as the birds grew older. The mean weight of the eggs laid during the 12-month period in lot I was 51.5 grams, and in lot II, 52.9 grams, the difference being statistically significant.

Amount and cost of feed consumed to produce a dozen eggs. The average number of birds during the year was 28.8 in lot II and 25.3 in lot I. During the 12-month period, the lot I birds consumed 886.2 kilograms, or an average of 35.06 kilograms of feed to a bird, and the lot II birds, 966.5 kilograms, or an average of 33.58 kilograms (table 3). The heavier feed consumption in lot I may be attributed to the heavier birds and the better egg production in this lot.

TABLE 3.—*Relative cost of feed and of eggs produced*

ITEM	LOT I	LOT II
Average weight of birds at the start, kilograms	1.54	1.30
Average weight of birds at the close, kilograms	1.87	1.67
Mean weight of birds, kilograms [a]	1.60	1.44
Total number of eggs produced	4,603	4,487
Mean weight of eggs, grams [a]	51.5	52.9
Total value of eggs produced, pesos [b]	552.36	538.44
Egg production per bird, per cent [c]	49.9	42.7
Number of eggs produced to a bird	182.1	155.9
Total amount of feed consumed, kilograms	886.2	966.5
Total cost of feed consumed, pesos [d]	224.21	244.52
Average feed consumption per bird, kilograms	35.06	33.58
Cost of feed consumed per bird, pesos	8.87	8.50
Feed needed to produce a dozen eggs, kilograms	2.32	2.58
Cost of feed needed to produce a dozen eggs, pesos	0.59	0.65
Number of birds that died	9	2
Mortality, per cent	30.0	6.7
Returns above feed cost, pesos	328.15	293.92

[a] Mean difference significant.
[b] Based on the average market price of ₱1.44 a dozen.
[c] Mean per cent difference not significant.
[d] Based on average cost of ₱0.253 a kilogram.

The total cost of feed consumed was ₱224.21 in lot I and ₱244.52 in lot II. To produce a dozen eggs, lot I required 2.32 kilograms of feed; lot II, 2.58 kilograms. Based on the average cost of ₱0.253 a kilogram of feed, lot I required ₱0.59 to produce a dozen eggs, and lot II, ₱0.65.

Mortality. The mortality rates in the two lots differed markedly. Of the 30 birds in each lot, nine died in lot I and only two in lot II. One bird in lot I was strangled by the self-feeder which slipped

from its place of attachment. Two of the deaths in the experimental lot and one in the control were due to *Ascaridia galli* Shrank, and the rest, to undetermined causes.

Minor observations. Two months after the experiment was started, the birds in the experimental lot appeared to be more active than those in the control lot. During the fourth month, however, a number of them showed poor appetites and discharged greenish droppings which weakened them and finally lead to their deaths. Most of the deaths occurred in May, June, and September.

During the molting season, the birds were observed to be inactive and sickly in appearance because they could not eat very well. Most of them had small, pale, dry, and shriveled combs and they decreased markedly in weight.

WEIGHTS AND MEASUREMENTS OF THE INTERNAL ORGANS AND PERCENTAGES OF THE WHOLESALE CUTS OF BERKJALA BARROWS [1]

ORLANDO A. PALAD

The average weight of 10 Berkjala barrows before fasting was 72.9 kilograms; that after fasting, 68 kilograms. The average dressed weight was 51.2 kilograms, and the average dressing percentage, 75.3. The heaviest cut was the shoulder, followed by the ham, side, head, back, hind feet, rump, forefeet, and leaf fat in the order mentioned.

To determine the percentages of the wholesale cuts, the weights and measurements of the internal organs, and the dressing percentages of Berkjala barrows, this study was conducted from January, 1953, to May, 1954.

Velarde [2] stated that for practical purposes, the lengths of the liver, the small intestine, and the trachea; the widths of the stomach and the liver; and the weights of the liver and the spleen may be used to determine the dressed weights of animals because these organs are easily separated, measured, and weighed. He further stated that the dressed weight of pigs can be roughly estimated from the increase in the measurement or weight of the internal organs.

MATERIALS AND METHODS

Ten Berkjala barrows with ages ranging from one year to one year and three months were fasted for 12 to 24 hours before slaughtering. They were weighed before and after fasting. After sticking and dressing, the head and internal organs were separated from the rest of the body. The carcass was split into two equal halves at the vertebral column and then divided into wholesale cuts. (fig. 1).

Wholesale cuts. The head was cut about 1.27 centimeters behind the ears down to the atlanto-occipital joint and was then twisted from the body.

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[1] Central Experiment Station Contribution No. 1862. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, October, 1954. Prepared in the Department of Animal Husbandry under the direction of Professor Valente Villegas and Mr. Avelino Manuel.

[2] M. A. Velarde, *Philippine Agriculturist,* 31, 66 (1946).

The shoulder was cut off from the carcass between the third and fourth ribs down across to the fore flank. The line of cut was at right angles to the back line.

The foreleg was removed from the shoulder at the elbow joint.

A cut parallel to the shoulder cut was made from the point of attachment of the tail down to the belly line. This cut minus the hind leg is the ham.

A cut perpendicular to the shoulder and ham cuts was made 1 centimeter below the first lumbar vertebra. This cut is parallel to the back line. To separate the back from the rump, a cut parallel to the shoulder cut was made between the last two lumbar vertebrae.

The side cut is the remaining cut after the ham, rump and back, and shoulder cuts have been removed.

The hind feet were cut off along the rear extension of the belly line.

The wholesale cuts were weighed separately in a balance of 20-kilogram capacity.

Internal organs. The internal organs were weighed in a balance of 2-kilogram capacity and a sensitivity of 2 grams. They were individually measured for length and width. All the widths were taken at the widest portions of the organs.

The length of the tongue was measured at the longest portion from the tip to the base where the median-glosso-epiglottic fold is located.

The trachea was measured from the anterior end to the point where it branches into the left and right lungs.

The small intestine was measured from the anterior end of the duodenum to the posterior end of the ileum which is attached to the caecum. The large intestine was measured from the caecum to the anterior end of the rectum. The length of the liver was taken on the dorsal surface.

The urinary bladder was measured from the neck to the vertex. The penis was measured from the base of the bulbo-cavernosus muscle to the external urethral orifice.

RESULTS AND DISCUSSION

Weights of internal organs. Animals with high dressing percentages had relatively heavier internal organs than those which had low dressing percentages (table 1). However, little variation

was noted in the weights of the heart, liver, spleen, tongue, stomach, large intestine, small intestine, penis, right lung, left lung, and left kidney. The coefficients of variation of the different internal organs are summarized in table 1.

TABLE 1.—*Mean weights of the different internal organs*

INTERNAL ORGAN	RANGE	MEAN + S.E.	COEFFICIENT OF VARIATION
	grams	*grams*	*per cent*
Heart	210– 240	218.6 ± 3.5	5.1
Larynx	70– 95	80.8 ± 3.1	12.3
Trachea	45– 70	58.4 ± 2.6	14.1
Liver	1555–1700	1615.5 ± 15.0	2.9
Spleen	170– 200	184.8 ± 3.3	5.7
Tongue	201– 240	221.5 ± 4.1	5.9
Oesophagus	45– 70	58.3 ± 2.4	13.3
Stomach	745– 780	763.8 ± 3.4	1.4
Large intestine	1139–1180	1159.7 ± 4.1	1.1
Small intestine	1186–1230	1208.1 ± 4.5	1.2
Urinary bladder	49– 75	60.2 ± 2.7	14.2
Penis	34– 45	38.2 ± 1.1	8.8
Left lung	285– 320	302.9 ± 3.9	4.1
Right lung	155– 200	179.0 ± 4.9	8.7
Left kidney	105– 135	119.0 ± 3.3	8.8
Right kidney	80– 115	96.6 ± 3.4	11.3

Measurements of internal organs. There were marked variations in the widths of the larynx, trachea, small intestine, urinary bladder, penis, and left lung (table 2).

There was no marked variation in the measurements of the heart among the 10 animals butchered. The range of length was 8.0 to 9.5 centimeters and the mean was 8.7 ± 0.2. The coefficient of variation was quite low, 7.4 per cent.

A marked variation in length of larynx was found. The range was 5.1 to 7.8 centimeters, or a mean of 6.5 ± 0.3 centimeters. The coefficient of variation was 15.3 per cent.

The range in length of trachea was 15.5 to 19.5 centimeters, or a mean of 17.4 ± 0.4 centimeters. Only a slight variation was noted in the measurements. The coefficient of variation was low, 6.7 per cent. Some animals had high dressing percentages although their tracheae were relatively short.

The length of the liver ranged from 17.5 to 25.0 centimeters, or a mean of 20.2 ± 0.7 centimeters. The increase in length of this

TABLE 2.—*Mean widths in centimeters of the internal organs*

WIDTH OF INTERNAL ORGAN	RANGE	MEAN ± S.E.	COEFFICIENT OF VARIATION
Heart	7.9–10.1	9.1 ± 0.2	8.4
Larynx	3.8– 5.7	4.5 ± 0.2	12.8
Trachea	1.8– 2.8	2.4 ± 0.1	13.1
Liver	25.0–32.1	27.2 ± 0.6	7.2
Spleen	4.9– 7.0	5.9 ± 0.2	9.5
Tongue	4.5– 6.0	5.2 ± 0.2	9.4
Oesophagus	1.1– 1.9	1.7 ± 0.3	15.1
Stomach	11.5–18.5	15.9 ± 0.8	16.3
Large intestine	7.2– 9.4	8.7 ± 0.2	7.1
Small intestine	2.4– 3.7	3.3 ± 0.1	13.5
Urinary bladder	4.9– 7.2	6.1 ± 0.3	13.1
Penis	0.8– 1.2	1.1 ± 0.1	12.0
Left lung	9.2–13.5	11.4 ± 0.5	12.9
Right lung	8.2–11.1	9.8 ± 0.3	9.3
Left kidney	4.9– 5.9	5.5 ± 0.1	8.0
Right kidney	5.0– 6.1	5.5 ± 0.1	7.3

organ became more marked as the live and dressed weights increased. The coefficient of variation was 10.8 per cent.

The range in length of spleen was 36.2 to 37.8 centimeters, or a mean of 37.1 ± 0.2 centimeters. The coefficient of variation was quite low, 1.4 per cent.

The length of the tongue ranged from 17.5 to 22 centimeters, or a mean of 19.5 ± 0.5 centimeters. This organ was longer in the heavier animals.

The range in length of large intestine was 445 to 487 centimeters, or a mean of 465.5 ± 4.2 centimeters. The coefficient of variation was very low, only 2.8 per cent.

The mean length of the small intestine was 1647.5 ± 5.8 centimeters; the coefficient of variation, 1.1 per cent.

The range in length of oesophagus was 34.3 to 37 centimeters, or a mean of 35.6 ± 0.3 centimeters. The variation in length was rather slight, the coefficient of variation being 2.7 per cent.

The penis had a mean length of 39.2 ± 0.2 centimeters. The range was 37.9 to 40.3 centimeters; the coefficient of variation was relatively low, only 2.0.

Although the urinary bladder is very small, the coefficient of variation was 11.00. The range in length was 8 to 10.5 centimeters, or a mean of 9.2 ± 0.3 centimeters.

The length of the left lung ranged from 22 to 27.2 centimeters, or a mean of 24.6 ± 0.6 centimeters. It was noted that the left lung was slightly larger than the right lung. This observation corroborates that of Velarde.[3]

The range in length of left kidney was 9.5 to 12.6 centimeters, or a mean of 11.3 ± 0.3 centimeters; that of the right kidney was 9.7 to 12.5 centimeters, or a mean of 11.4 ± 0.3 centimeters. These results differ from those obtained by Velarde who reported that the left kidney was longer than the right. In the present study, the exact measurements could not be taken because the kidneys had lesions caused by kidney worms. The coefficient of variation for the left kidney was 8.6 per cent; that for the right kidney, 7.2 per cent.

Slaughter data. The average weight of the animals before fasting was 72.9 kilograms; that after fasting, 68 kilograms. Most of the animals with heavy live weights had correspondingly heavy dressed weights (table 3). The dressing percentages of most of the animals ranged from 70.9 to 78.9. One animal had an exceptionally high dressing percentage, 81.1.

TABLE 3.—*Slaughter data*

HERD NUMBER	LIVE WEIGHT		LOSS	DRESSED WEIGHT	DRESSING PERCENTAGE
	Before	After			
	kg.	*kg.*	*kg.*	*kg.*	
1454	78.6	74.0	4.6	55.0	74.3
1453	65.0	63.6	1.4	51.6	81.1
1464	55.0	50.0	5.0	36.7	73.6
1455	91.0	90.0	1.0	68.9	76.6
1435	76.0	72.0	4.0	54.6	75.8
1432	83.0	79.4	3.6	56.3	70.9
1463	59.0	55.0	4.0	41.7	75.8
1526	75.0	69.0	6.0	49.5	71.7
1541	71.8	62.0	9.8	48.9	78.9
1527	75.0	65.0	10.0	48.6	74.8
Mean	72.9	68.0	4.9	51.2	75.3

Villegas and Mondoñedo[4] reported that the average dressing percentage of Berkjala pigs slaughtered in the College of Agriculture was 73.2. Well-finished yearling barrows of the same breed had an average dressing percentage of 79.2.

[3] *Ibid.*

[4] V. Villegas and M. Mondoñedo, *U.P. Coll. Agric. Exper. Sta. Cir.*, 31 (1938).

Cutting yield and relation to carcass. The heaviest cut from the carcasses of Berkjala barrows was the shoulder, followed by the ham, side and spareribs, head, back, hind feet, rump, forefeet, and leaf fat (table 4). The relation, expressed in per cent, between the weights of the different cuts and the dressed weights of the animals was as follows: head, 12.4; shoulder, 30.2; ham, 18.5; hind feet, 4.5; forefeet, 3.6; rump, 4.2; back, 9.1; side and spareribs, 14.3; and leaf fat, 3.3.

TABLE 4.—*Mean weights of wholesale cuts*

CUT	RANGE	MEAN + S.E.	COEFFICIENT OF VARIATION
	kg.	*kg.*	*per cent*
Head	5.0– 8.4	6.3 ± 0.3	14.3
Shoulder	10.7–21.1	15.4 ± 0.9	18.3
Ham	6.8–12.5	9.5 ± 0.6	20.4
Hind feet	1.6– 3.1	2.3 ± 0.1	16.4
Fore feet	1.2– 2.5	1.8 ± 0.1	18.5
Rump	1.5– 2.7	2.1 ± 0.1	20.1
Back	3.5– 6.4	4.6 ± 0.3	22.8
Side	5.0–10.2	7.4 ± 0.5	23.7
Leaf fat	1.2– 2.5	1.7 ± 0.1	27.0

Elazegui [5] found that the coefficients of correlation of the dressed weights to the live weights and to the weights of the wholesale cuts were all highly significant.

[5] M. R. Elazegui, *Philippine Agriculturist*, 35, 273 (1948).

TESTS OF SOME INSECTICIDAL SPRAYS IN THE CONTROL OF INSECTS AFFECTING PECHAY [1]

VICTORINO Y. DE DIOS

Of the insecticides tested, only dieldrin had a slight burning effect on the leaves. DDT and methoxychlor did not show any burning effect on any part of the plants.

Dieldrin-treated plots gave the highest total mean yield of 1,592.3 grams in the two-spray treatment. DDT-treated plots gave the highest mean yield of 2,176.5 grams in the four-spray treatment. The difference in yield between plots and the control was highly significant. The difference in yield between the plots given the two- and four-spray treatments was not significant. Greater benefit was obtained by spraying DDT and dieldrin four times.

The plots sprayed with DDT according to the two-spray and the four-spray schedule gave the highest mean percentages of leaves undamaged by caterpillars. The dieldrin-treated plots had the highest percentage of leaves uninfested with aphids. In the four-spray treatment DDT was the best. In the plots given the two-spray or the four-spray treatment DDT and dieldrin gave the best protection against the insect pests.

The large-scale cultivation of pechay or Chinese cabbage (*Brassica pekinensis* [Lour.] Skeels) favors the rapid multiplication of the insect pests of this crop. Yet, farmers give little attention to the control of insects attacking pechay because of the lack of adequate information on the subject.

The present study was conducted from November, 1954, to May, 1955, on a piece of land belonging to the UP Rural High School and in the laboratory of the Department of Entomology to determine (a) the effect of some insecticidal sprays against some of the known insect pests of pechay, (b) the effect of the treatments on the yield, and (c) the burning effect of the sprays on the crop.

MATERIALS AND METHODS

Three insecticidal concentrates were tested: (1) a 50 per cent DDT-wettable powder,[2] (2) a 50 per cent methoxychlor wettable

[1] Central Experiment Station Contribution No. 1863. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, June, 1955. Prepared in the Department of Entomology under the direction of Dr. G. B. Viado.

[2] Gesarol AK 50, a Geigy Co. product.

powder,[3] and (3) a 15.8 per cent dieldrin emulsifiable concentrate.[4] The three insecticides were diluted with tap water in the following proportions: Gesarol, 2.5 grams to a liter of water; Marlate, 3 grams to a liter; and Dieldrex, 3 cc. to a liter. They were sprayed with a compressed-air hand sprayer with two-gallon capacity. Pressure was maintained between 25 and 45 pounds to a square inch.

Pechay seeds of the commercial Chinese variety were coated with one-half tablespoonful of Arasan Sf-X [5] before planting. All the necessary care was given the seedlings to insure their vigorous growth. Ammonium sulfate fertilizer containing 20 per cent nitrogen was applied twice in the form of a solution made by mixing thoroughly 10 grams of the fertilizer with every 10 liters of water. The first application was made when the seedlings were two weeks old, and the second, ten days after the first application. After each application, the seedlings were sprinkled with water to wash out the fertilizer which might cause burning on the leaves. The seedlings were thinned when they had one or two pairs of true leaves.

The field was prepared with four blocks representing four replications. Each block consisted of seven plots, one of which was a control plot. Three rows were made in each plot. Seven plants were planted to a row at a distance of 25 centimeters each way. Treatments were randomized in the plots. The seedlings were planted at the same time and dead plants were replaced immediately to insure uniform growth.

The plants were sprayed between 7 and 10 o'clock in the morning by two methods: twice at ten-day intervals, and four times at five-day intervals. The first spraying was done when the plants were three weeks old, and the last, ten days before harvesting. A piece of cardboard measuring 1 × 1 meter was used to fence a plot during spraying to prevent the contamination of the neighboring plots. Spraying was done evenly to prevent depositions of the spray on the leaves.

After each spraying the effects of the different insecticides on the parts of the plants were observed. The relative abundance of the insects affecting the plants was also noted in each plot before and after spraying.

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[3] Marlate 50, a du Pont product.
[4] Dieldrex 15, a Shell Chemical Corp. product.
[5] A product of Du Pont de Nemours and Co., Inc., containing 75 per cent tetramethylthiuramdisulfide.

The plants, except those in the border rows, were harvested at maturity and observed for (1) total number of plants in each plot, (2) total number of leaves, (3) number of undamaged leaves, and (4) total weight of the plants in each plot and the average weight of one plant. The degree of damage on the plants and the burning effect of insecticides were also observed.

The effects of the sprays on the insects affecting the plants were studied in the laboratory. Each insecticide test had two replications, and a check was always maintained.

In the test on the larvae of *Crocidolomia binotalis,* one leaf treated with one insecticide was placed beside an untreated leaf in a glass bottle containing water. Ten larvae were placed directly on the treated leaf. The same procedure was followed in the tests on the larvae of *Heliothis armigera* and *Prodenia litura.*

In the test on *Phyllotreta* sp. empty ball jars were used. A treated leaf was placed beside an untreated leaf in a glass bottle. Thin cheesecloth covered the mouths of the ball jars.

In the test on *Aphis brassicae* Linn., 100 insects were placed on the leaves of a young plant and were sprayed with insecticide. The potted plant was placed on white paper and the number of aphids that fell was counted.

The repellent action of the insecticides, whether the insects fed on the treated leaf or not, the extent of feeding, and the number of dead larvae were noted every 12 hours.

DISCUSSION OF RESULTS

Field tests

Insect species attacking pechay. The insects that attacked the pechay plants in the field were (1) *Crocidolomia binotalis* Zeller, (2) *Heliothis armigera* Hubner, (3) *Prodenia litura* Fabr., (4) *Phyllotreta* sp., and (5) *Aphis brassicae* Linn.

Burning effect of the sprays. The three insecticidal sprays tested did not damage the plants. Dieldrin had a slight burning effect on the leaves. The damage was observed after less than one day, but the leaves were not seriously affected and recovered after two days. Viado and Banaag (1954) reported that Dieldrex damaged the leaves, stalk, tassels, and ears of corn after 24 hours, but they were able to recover four days after.

DDT and methoxychlor showed no burning effect on the leaves of pechay although white residues of DDT were noticed on the leaves.

Smith and Goodhue (1945) reported that DDT even at high dosages did not injure a wide range of plants, with the exception of cucumber. Helson and Greaves (1945) reported that DDT dust did not injure the various crops to which it was applied. Pashfield (1945) reported that cabbages dusted with DDT were eaten by men and various domestic animals without any apparent ill effect. Martin and Miles (1952) reported that methoxychlor is generally nonphytotoxic.

Effect on yield. In the two-spray treatment, dieldrin gave the highest mean yield of 1,592.3 grams (table 1). The average increases in mean yield over the control were 354.0 grams for dieldrin, 352.4 grams for methoxychlor, and 293.5 grams for DDT. All the treatments were significantly better than the control at the 1 per cent level.

TABLE 1.—*Yield in grams of the different treatments based on 15 plants to each treatment*

INSECTICIDE	TREATMENT	REPLICATION				TOTAL	MEAN
		I	II	III	IV		
DDT	2×	1,593.0	1,522.5	1,603.6	1,440.1	6,159.2	1,531.8
	4×	1,695.4	2,398.7	2,452.1	2,159.7	8,705.9	2,176.5
Methoxychlor	2×	1,674.7	1,585.7	1,506.8	1,595.6	6,362.8	1,590.7
	4×	1,949.4	1,948.2	1,705.1	1,670.5	7,273.2	1,818.3
Dieldrin	2×	1,328.1	1,558.0	1,903.5	1,579.6	6,369.2	1,592.3
	4×	2,049.3	1,996.3	2,274.4	1,994.2	8,314.2	2,078.6
Control		1,313.5	1,109.5	1,226.0	1,304.2	4,953.2	1,238.3
Total		11,603.4	12,118.9	12,671.5	11,743.9	48,137.7	

Analysis of variance

SOURCE OF VARIANCE	DF	SS	MS	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Replication (R)	3	97,598.27	32,532.76	0.96	3.16	5.09
Treatment (T)	6	2,576,474.75	429,412.46	12.73	2.66	4.01
R × T	18	607,290.17	33,738.34			
Total	27	3,281,363.19				

SMD at 5% (T) = 272.71
SMD at 1% (T) = 376.16

Among the plots which received the four-spray treatment DDT gave the highest mean yield. The sprays gave the following increases in yield over the control: DDT, 938.3; dieldrin, 840.3; and

methoxychlor, 580.0 grams. All the treated plots were significantly better than the control at the 1 per cent level.

The difference in yield between the DDT-sprayed plots in the two-spray treatment and those in the four-spray treatment was highly significant, showing the higher degree of effectiveness of the four applications of the insecticide. The same was true for dieldrin. With methoxychlor, the difference was insignificant. DDT and dieldrin applied according to the four-spray schedule gave greater benefits than when applied according to the two-spray schedule.

The effectiveness of DDT against many insects on vegetables has been reported by Boyce (1944), Smith and Harrison (1944), Apple (1945), Greaves (1945), Leary *et al.* (1946), and Smith (1946).

Based on the mean percentages of plants with undamaged leaves, DDT gave the best control against the caterpillars which attacked the leaves in the plots sprayed twice (table 2). A comparison of the mean percentages of the treated and untreated plants

TABLE 2.—*Efficacy of some insecticidal sprays based on the transformed angles of percentages of undamaged leaves* [a]

INSECTICIDE	TREATMENT	REPLICATION				TOTAL	MEAN ANGLE	MEAN	PER CENT
		I	II	III	IV				
DDT	2×	77.61	79.19	66.66	70.36	293.82	73.46	58.95	73.00
	4×	83.98	84.26	82.08	72.54	322.86	80.72	63.94	80.00
Methoxychlor	2×	75.00	60.27	67.45	64.01	266.73	66.68	54.70	66.00
	4×	77.08	64.38	77.61	79.06	298.13	74.53	59.67	74.00
Dieldrin	2×	74.88	75.70	76.31	73.36	300.25	75.06	60.00	75.00
	4×	82.08	74.88	78.17	73.78	308.91	77.23	61.48	77.00
Control		29.20	30.07	39.82	33.83	132.92	33.23	35.18	33.00
Total		499.83	468.75	488.10	466.94	1923.62			

[a] Leaves undamaged by aphids.

Analysis of variance

SOURCE OF VARIANCE	DF	SS	MS	COMPUTED F-VALUE	TABULAR F-VALUE	
					5%	1%
Replications (R)	3	107.53	35.84	1.39	3.16	5.09
Treatments (T)	6	6305.52	1050.92	40.72	2.66	4.01
R × T	18	464.60	25.81			
Total	27	6877.65				

SMD at 5% (T) = 7.54
SMD at 1% (T) = 10.33

shows that DDT reduced the infestation over the control by about 28.00, dieldrin by 24.00, and methoxychlor by 16.00. All the treated plots were significantly higher at the 1 per cent level.

In the plots sprayed four times, DDT was highly effective in reducing the damage, the difference over the control being 36.00 per cent. Dieldrin, with a difference over the control of 35.00 per cent, was next best; methoxychlor, with 23.00 per cent, was the least effective in reducing damage. All the treated plots had significantly less damaged leaves than the control. Greater benefits were gained by spraying the plants four times with DDT and dieldrin. Little benefit was obtained from spraying methoxychlor four times. The difference between the percentages of DDT and dieldrin in each schedule of spraying was not significant.

Dieldrin gave the highest mean percentage of unattacked leaves, followed by DDT. When the mean percentages of the untreated plots were compared with that of the control in the two-spray test, dieldrin was found to have reduced the infestation by 42.00, DDT by 41.00, and methoxychlor by 33.00 per cent.

In the four-spray schedule, DDT reduced the infestation most, followed very closely by dieldrin. The DDT-treated plots differed over the control by about 47.00; the dieldrin-treated plots, by 44.00; and the methoxychlor-treated plots, by 41.00. All the treated plots were significantly better than the control at the 1 per cent level. There were no significant differences between the two schedules of spraying.

The flea beetles were heavy on the control and the treated plants before treatment as compared with those on the treated plants after two days. Many dead flea beetles were noted on the ground after each spraying in the treated plots. DDT and dieldrin were highly effective against this insect. The plants in the treated plots, especially those treated with DDT and dieldrin, appeared to be healthier and showed better growth than those in the control plots. Stapel and Peterson (1945) reported that DDT reduced *Phyllotreta* sp. on Swedes and yellow mustard. Huckett (1946) reported that all DDT treatments were effective against cauliflower insects and that the plants remained green much later in the season.

The caterpillars were abundant throughout the experiment in the control plots and moderately abundant in all the plots which received the two-spray treatment. In the plots which received the four-

spray treatment, insects were relatively fewer and were sometimes not to be found at all.

Aphids were most abundant in the control plots and less abundant in the treated plots. Not one of the insecticides in both the two- and four-spray treatments was able to control the aphids completely.

Laboratory tests

On the larvae of Crocidolomia binotalis. The three insecticidal sprays killed the larvae at varying lengths of time. A complete kill was observed with DDT after 48 and 60 hours. Dieldrin gave a complete kill after 60 hours, and methoxychlor after 72 hours. The larvae did not feed on leaves treated with dieldrin and DDT, but they crawled on the treated leaves. They fed on the leaves treated with methoxychlor and on the untreated leaf of the control. Not a single insect died during the test.

On the larvae of Heliothis armigera. A complete kill of the larvae was observed on the leaves treated with DDT after 72 hours. Both methoxychlor and dieldrin gave complete kill between 84 and 96 hours. The larvae did not feed on the leaves treated with DDT and dieldrin. They fed on the untreated leaves and on those treated with methoxychlor. Not a single insect died on the control during the test.

On the larvae of Prodenia litura. All the larvae were found dead on the leaves treated with dieldrin and DDT between 48 and 60 hours after treatment. Methoxychlor gave a complete kill after 72 hours. DDT gave the fastest killing effect, and methoxychlor gave the slowest. On the control, not a single insect died during the test. The larvae did not feed on the leaves treated with DDT and dieldrin because of the repellent action of the insecticides. They fed on the untreated leaves and on those treated with methoxychlor and crawled on both the treated and untreated leaves.

On Phyllotreta sp. A complete kill was observed on the leaves treated with dieldrin after 24 hours. DDT gave a complete kill between 24 and 36 hours after treatment. Methoxychlor gave a complete kill after 36 hours. The insects on all the treatments fed very slightly on the treated leaves. Viado and Estioko (1951) reported that *Psylliodes balyi* and *P. splendida* on eggplant did not feed on leaves treated with DDT and methoxychlor. Not a single insect on the control died during the test. The beetles fed more on the untreated leaves.

On Aphis brassicae. Dieldrin killed most of the aphids after 60 hours, followed by DDT. Methoxychlor gave the slowest killing effect. Aphids treated with the three insecticides became mobile and were disturbed after spraying. On the other hand, aphids on the control plant remained undisturbed, but the leaves of the plant showed faster yellowing and drying.

LITERATURE CITED

APPLE, J. W. 1945. DDT to control cabbage caterpillars. Jour. Econ. Entom. 38: 410.

BOYCE, A. M. 1944. Gesarol, a promising agricultural insecticide. Rev. Applied Entom. 32: 146.

GREAVES, T. 1945. Experiments on the control of cabbage pests in northern Queensland. Jour. Coun. Sci. Indus. Res. Aust. 18: 110-120.

HELSON, G. A. H., AND T. GREAVES. 1945. Control of cabbage worms in northern Queensland. Jour. Coun. Sci. Indus. Res. Aust. 18: 304.

HUCKETT, H. C. 1946. DDT and other insecticides for control of cauliflower worms on Long Island. Jour. Econ. Entom. 39: 46-47.

LEARY, JAMES C., WILLIAM FISHBEIN, AND LAWRENCE SALTER. 1946. DDT and the insect problem. v + 165 p. McGraw-Hill Book Co., Inc.

MARTIN, H., AND S. R. W. MILES. 1952. Guide to chemicals used in crop protection. Science Service Laboratory. Univ. of Western Ontario Sub Post Office: 122-123.

PASHFIELD, G. 1946. Control of cabbage pests with DDT and 666 dusts. Rev. Applied Entom. 34: 386.

SMITH, J. H. 1946. A new insecticide-DDT. Rev. Applied Entom. 34: 386.

SMITH, C. E., AND P. K. HARRISON. 1944. Field test of DDT and other insecticides against cabbage caterpillars. Jour. Econ. Entom. 37: 152.

SMITH, R. F., AND L. D. GOODHUE. 1945. DDT Aerosols to control onion thrips and other pests in greenhouses. Jour. Econ. Entom. 38: 177.

STAPEL, C., AND H. I. PETERSON. 1946. Test of chemical control measures against diseases and pests of plants. Rev. Applied Entom. 34: 7.

VIADO, G. B., AND AVELINO F. BANAAG. 1954. Test of some insecticides in the control of insects affecting corn. Philippine Agriculturist 38: 419-435.

VIADO, G. B., AND ROMAN R. ESTIOKO, JR. 1951. Test of five insecticidal dusts in the control of insects affecting tomatoes and eggplants. Philippine Agriculturist 35: 343-357.

SOME ASPECTS OF MARKETING VEGETABLES IN LA TRINIDAD, MOUNTAIN PROVINCE [1]

TEODORO B. BAGUILAT

Of the temperate vegetables, cabbage and lettuce were the most extensively grown by the 49 Filipino farmers visited in La Trinidad. Beans was the crop most commonly grown. The highest average annual receipts of ₱421 per farm were obtained from cabbage.

All the farmers raised their crops mostly for the market. The common market outlet, particularly for the small growers, was the Baguio public market. The produce was sold wholesale to vegetable stall operators. As production per farm increased, however, producers tended more to sell at the farm or to ship to the Manila market.

Prices received varied for the different vegetables and the different market outlets. Washing, trimming, cleaning, topping, and general sorting of produce were usually practiced. The harvest was packed in bamboo baskets and loaded in motor trucks for the Baguio market. Marketing costs included transportation fare of the grower, freight charge of the produce, and payment for the delivery of the load from the terminal to the vendor's stall.

The vegetable bowl of La Trinidad, Mountain Province, is 4 kilometers north of Baguio City. Mountain ranges covered by pine trees encircle the valley. The plain is cut by a river that overflows annually. The topography and the cool climate make the locality suitable for the growing of temperate vegetables. It has been popularly referred to as the "vegetable garden of the Philippines."

THE FARMERS

Forty-nine Filipino farmers were visited in 1954. These farmers produced an important part of the vegetables in the valley. Their average age was 40 years. Their farming experience averaged 15 years. They had been operating their present farms for an average of 13 years. Their years in school averaged seven.

Thirty-nine per cent of the farmers had had intermediate schooling (table 1). Twenty-one per cent had graduated from the Trini-

[1] Central Experiment Station Contribution No. 1864. Taken from the thesis presented by the author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, April, 1955. Prepared in the Department of Agricultural Economics under the direction of Instructor Andres D. Goseco.

dad Agricultural High School; 10 per cent, from other high schools. Only 6 per cent had not attended school.

TABLE 1.—*Educational attainment of 49 Filipino vegetable growers*

EDUCATIONAL ATTAINMENT	NUMBER	PER CENT
No schooling	3	6
Primary (1st–4th grades)	6	12
Intermediate (5th–7th grades)	19	39
High school (1st–4th years)	6	12
Graduate of Trinidad Agricultural High School	10	21
Graduate of other high schools	5	10
Total	49	100

VEGETABLES GROWN AND MARKETED

The 49 Filipino vegetable growers planted 28 different vegetables on a total area of 29 hectares. The average area per farm was 5,968 square meters, or about .6 hectare. The annual gross receipts amounted to ₱1,248 per farm.

Cabbage was the leading crop based on area planted, production, and annual receipts per farm (table 2). Lettuce was a consistent second. The two crops utilized 45 per cent of the area planted and made up 55 per cent of the annual receipts.

TABLE 2.—*Area planted, production, and annual receipts per farm of 10 ranking vegetables*

VEGETABLE	AREA PLANTED	PRODUCTION	ANNUAL RECEIPTS
	sq. meters	*kilos*	*pesos*
Cabbage	1,550	2,469	421
Lettuce	1,151	1,180	201
Beans	783	445	86
Pechay	487	492	83
Wong-bok	349	391	88
Celery	324	193	101
Onion	309	232	33
Irish potato	249	86	30
Peas	152	38	29
Mustard	117	80	92
Other [a]	497	—	86
Total	5,968	—	1,150

[a] Includes sweet potato, chayote, radish, beets, carrots, spinach, sweet pepper, eggplant, water cress, summer squash, rhubarb, tomato, cauliflower, cucumber, broccoli, kohlrabi, and gabi.

The area planted was not indicative of the relative importance of vegetables because some were more intensively grown than others so that value per unit area planted was much more. The relatively higher market values of some crops like peas and Irish potato did not attract many growers into cultivating them because their culture is more exacting and therefore involves more expenses and effort. Cabbage and lettuce, although valued lower, were more widely grown.

Cabbage and lettuce represented 50 per cent of all sales (table 3). Cabbage alone represented one-third. Total sales corresponded to total value of produce. Again, cabbage and lettuce constituted about one-half of the total value of produce.

TABLE 3.—*Percentage of total sales and of total value of produce of 10 ranking vegetables*

VEGETABLE	PERCENTAGE OF	
	Total sales [a]	Total value [b]
Cabbage	34	32
Lettuce	16	17
Celery	8	7
Mustard	7	7
Wong-bok	7	7
Beans	7	7
Pechay	7	6
Onion	3	3
Irish potato	2	2
Peas	2	3
Other	7	9
Total	100	100

[a] ₱61,134.
[b] ₱68,408.

AVERAGE ANNUAL RECEIPTS

The majority of the growers planted beans (table 4). Unlike leafy vegetables, beans, in the form of dry seeds, can be stored readily. When the market is low, the bean pods, which are ordinarily sold green, are allowed to mature. They can then be sold later as bean seeds at much higher prices.

Only 55 per cent of the farmers planted cabbage, but their average annual receipts were highest. Seventy-three per cent planted lettuce, but their annual receipts were less than a half of those for cabbage. Of the 10, celery, the least popular, gave the second best

TABLE 4.—*Number of farmers reporting, percentage of all farmers, and average annual receipts per farm for 10 leading vegetables*

VEGETABLE	NUMBER OF FARMERS REPORTING	PERCENTAGE OF TOTAL [a]	AVERAGE RECEIPTS PER FARM REPORTING
Beans	38	77	₱110
Lettuce	36	73	274
Pechay	31	63	131
Onion	30	61	54
Cabbage	27	55	763
Irish potato	17	35	85
Peas	17	35	83
Wong-bok	14	28	307
Mustard	12	24	373
Celery	11	22	448

[a] Forty-nine farmers.

average receipts. Differences in costs and difficulties of raising and marketing some of the crops account for the seeming discrepancies in the actions of the farmers.

RETURNS PER HECTARE

There was a wide variation in the returns per hectare of the various vegetable crops (table 5). Many of the relatively unimportant crops as measured by area planted had high returns per hectare.

The costs and problems of production and marketing are just as important as returns in determining the areas that will be devoted to a crop. To the extent that farmers act rationally, the relationship between costs and problems and returns determines what they will grow on their land.

METHODS OF DISPOSAL

The proportion of total production sold ranged from 77 per cent for lettuce to 98 per cent for celery (table 6). "Home use" varied from 1 per cent for celery to 8 per cent for peas, whereas "other uses" fluctuated from 1 per cent also for celery to 21 per cent for lettuce.

The proportion of the beans that was sold tended to be higher with increasing production (table 7). In contrast, home consumption showed an inverse relation to production. "Other uses" suggested the same tendency.

TABLE 5.—*Area planted and returns per hectare*

VEGETABLE	AREA PLANTED ON 49 FARMS	RANK	RETURNS PER HECTARE	RANK
	sq. meters		*pesos*	
Cabbage	75,960	1	2,922	12
Lettuce	56,405	2	2,022	18
Beans	38,390	3	1,214	25
Pechay	23,880	4	1,868	20
Wong-bok	17,090	5	2,831	14
Celery	15,880	6	3,142	9
Onion	15,150	7	1,237	24
Irish potato	12,190	8	1,416	23
Sweet potato	7,950	9	1,416	22
Peas	7,430	10	2,378	17
Carrots	5,770	11	3,179	8
Mustard	5,760	12	7,835	2
Sweet pepper	3,300	13	1,499	21
Spinach	1,700	14	2,880	13
Radish	1,580	15	2,544	15
Chayote	1,194	16	5,779	3
Beets	610	17	3,736	7
Water cress	540	18	1,097	26
Tomatoes	510	19	2,929	11
Eggplant	380	20	4,015	6
Summer squash	220	21	2,965	10
Cauliflower	200	22	5,400	4
Broccoli	200	23	450	27
Gabi	100	24	12,000	1
Rhubarb	50	25	4,560	5
Cucumber	40	26	2,500	16
Kohlrabi	20	27	1,875	19

TABLE 6.—*Total production and disposal methods of 10 leading vegetables*

VEGETABLE	TOTAL PRODUCTION [a]	PER CENT		
		Sold	Home use	Other uses [b]
	kilos			
Cabbage	120,998	93	3	4
Lettuce	57,804	77	2	21
Pechay	24,132	91	5	4
Beans	21,809	90	6	4
Wong-bok	19,141	89	7	4
Celery	9,465	98	1	1
Onion	11,378	85	3	12
Irish potato	4,221	81	7	12
Mustard	3,917	93	2	5
Peas	1,868	78	8	14

[a] Total on 49 farms.
[b] Include gifts, seeds, feed for animals, and composting materials.

TABLE 7.—*Disposal of beans*

PRODUCTION IN KILOS	PER CENT		
	Sold	Home use	Other uses [a]
Less than 199	81	10	9
200–499	87	8	5
500 and more	91	5	4

[a] Include gifts, seeds.

The proportion sold showed little relation to change in cabbage production (table 8). The proportion consumed at home showed an inverse relationship.

TABLE 8.—*Disposal of cabbage*

PRODUCTION IN KILOS	PER CENT		
	Sold	Home use	Other uses [a]
Less than 1,199	90	8	2
1,200–4,899	85	5	10
4,900 and more	95	2	3

[a] Include gifts, feed for animals, and composting materials.

Lettuce and pechay showed no positive correlation in production and disposal (tables 9 and 10). An otherwise proportionate trend was obscured by the irregular tendency of "other uses" in lettuce and "home use" in pechay. The inconsistency of "other uses" in lettuce was due to a large-scale grower who used a large portion of his produce for poultry feed.

TABLE 9.—*Disposal of lettuce*

PRODUCTION IN KILOS	PER CENT		
	Sold	Home use	Other uses [a]
Less than 299	79	10	11
300–999	96	2	2
1,000 and more	76	1	23

[a] Include gifts, feed for animals, and composting materials.

TABLE 10.—*Disposal of pechay*

PRODUCTION IN KILOS	PER CENT		
	Sold	Home use	Other uses [a]
Less than 149	92	8	[b]
150–399	83	12	5
400 and more	93	4	3

[a] Include gifts, feed for animals, and composting materials.
[b] Less than 1 per cent.

MARKET OUTLETS

The produce was sold in three market outlets. The farmers usually sold their crops wholesale to vegetable vendors at the Baguio City public market. Only one farmer retailed his own produce. Thompson [2] remarked that retailing is not popular with growers because it is expensive and most growers value the time spent on the farm more than that spent in selling in small lots to the consumer.

The type of market outlet was closely related to the quantity of cabbage produced (table 11). Small producers tended to sell all their produce at the public market in Baguio City. Sixty-nine per cent of the production of farmers with production ranges of 1,200 to 4,899 kilos was sold at the public market. Thirty-one per cent was sold at the farm to wholesale buyers. When production was more than 4,900 kilos, percentages sold at the Baguio public market and at the farm further decreased. Twenty-eight per cent of the produce was shipped to the Manila market.

TABLE 11.—*Cabbage disposal by type of market outlet*

PRODUCTION IN KILOS	PER CENT		
	Retailers (Baguio public market)	Wholesale buyers at farm	Shipments to Manila
Less than 1,199	100	—	—
1,200–4,899	69	31	—
4,900 and more	60	12	28

The proportion of lettuce sold at the public market and that sold at the farm followed opposite tendencies with increasing production (table 12). Most of the production was disposed of in the Baguio market. Only 3 per cent of the total produce was shipped to Manila.

TABLE 12.—*Lettuce disposal by type of market outlet*

PRODUCTION IN KILOS	PER CENT		
	Retailers (Baguio public market)	Wholesale buyers at farm	Shipments to Manila
Less than 299	68	32	—
300–999	62	38	—
100 and more	47	50	3

Pechay was sold in two outlets only (table 13). All sales by farmers in the low range of production were made at the public mar-

[2] H. C. Thompson, "Vegetable Crops," McGraw-Hill Book Co., New York, 1949.

ket. In the higher ranges, the proportion sold at the public market decreased. Thirty-five per cent of the production in the highest range was sold to wholesale buyers at the farm.

TABLE 13.—*Pechay disposal by type of market outlet*

PRODUCTION IN KILOS	PER CENT		
	Retailers (Baguio public market)	Wholesale buyers at farm	Shipments to Manila
Less than 149	100	—	—
150–399	96	4	—
400 and more	65	35	—

Most of the bean sales were made at the Baguio public market (table 14). Fourteen per cent of the production of growers in the production range of 500 kilos and more per farm was shipped directly to Manila. Only a small portion of the total sales was made at the farm.

TABLE 14.—*Bean disposal by type of market outlet*

PRODUCTION IN KILOS	PER CENT		
	Retailers (Baguio public market)	Wholesale buyers at farm	Shipments to Manila
Less than 199	92	8	—
200–499	100	—	—
500 and more	83	3	14

PRICES RECEIVED

Of the 10 ranking vegetables, peas brought the highest average price at the public market and at the farm (table 15). Cabbage

TABLE 15.—*Price paid per kilo for 10 ranking vegetables in two market outlets*

VEGETABLE	PESOS PER KILOGRAM	
	Retailers (Baguio public market)	Wholesale buyers at the farm
Cabbage	₱0.16	₱0.21
Lettuce	0.23	0.32
Celery	0.53	0.53
Mustard	0.25	0.24
Wong-bok	0.24	0.30
Beans	0.22	0.18
Pechay	0.18	0.28
Onion	0.18	0.18
Irish potato	0.41	0.28
Peas	0.94	0.90

brought the lowest price at the public market. Peas, Irish potato, mustard, and beans sold cheaper at the farm. Prices for celery and onions did not differ with market outlet.

PREPARATION OF VEGETABLES FOR THE MARKET

Preparing the produce for the market is necessary to maintain quality and to give attractiveness to the vegetables. Washing removes dirt and freshens the produce. The absorption of water restores wilted tissues. Onions, radishes, carrots, beets, and sweet potatoes were always washed by the operator. Leafy vegetables were only rinsed to wash out soil particles.

Work [3] also observed that appearance can be improved and transportation and handling costs reduced by the removal of discolored, dead, or damaged parts. The common practice of the vegetable growers was to strip the outermost leaves of leafy vegetables like cabbage, lettuce, and wong-bok. At the Baguio public market, the retailers further culled bruised and broken leaves.

SELECTION OF PRODUCE

The separation of products into grades is the trend in vegetable marketing (Work, 1950).[4] While no grading practices were followed by the vegetable farmers, sorting was practiced to obtain a higher price. Sorting for size was done for most of the leafy vegetables. Irish potatoes were classified on the basis of size into large, medium, and small. Usually, though, the small potatoes were kept for home use.

Because pechay plants bearing early blossoms tended to net better prices than those without, some farmers preferred to harvest only those with young flowers.

With the other vegetables, selection for quality depended on general appearance, freedom from blemishes, and maturity. The produce of poorer quality was generally reserved for home use.

CONTAINERS AND TRANSPORTATION COSTS

The produce was usually packed in bamboo baskets, about 2 to 2½ feet wide and 3½ to 4 feet high. This basket cost ₱1.00. A smaller basket sold for ₱0.50.

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[3] P. Work, "Vegetable Production and Marketing," John Wiley & Sons, Inc., New York, 1950.

[4] *Ibid.*

From La Trinidad the produce was transported to the Baguio public market in motor trucks. One-way travel cost the grower ₱0.10 for passenger's fare and ₱0.10 per basket for freight. Shipments to Manila were loaded in freight trucks.

Selling to retailers at the public market involved the hiring of boys equipped with push carts to deliver the load to the vendor's stall. Five centavos was charged per basket load.

PROBLEMS

Personal problems arose because of the farmer's individualistic operations. Balmaceda [5] referred to the marketing methods of the average Filipino farmer as individualistic and haphazard.

Shipments to the public market were generally small. The growers usually disregarded prevailing market conditions. Despite low prices, immediate harvesting and shipment to the market were necessary to avoid deterioration. As a result, farmers often received very low prices for their produce.

Breakage and scarring of produce were invariably incurred on account of disturbances in transit and the rough inner lining of the bamboo baskets used. The more particular vendors at the public market discarded the vegetables with broken and bruised parts.

One important production problem which directly affects marketing is decreasing soil fertility. Commercial fertilizers and insecticides are becoming more indispensable. The increased production costs often reduce the net returns of the farmer.

The small Trinidad vegetable growers, as a whole, are competing with the larger growers from farther north in the Mountain Trail where vegetable "terraces" are being carved out of the virgin forests.

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[5] C. Balmaceda, *Agric. Ind. Life* 12, 6 (1950).

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